the
UNIVERSITY
of
TORONTO
MEDICAL
JOURNAL

MAR. 1969 VOL. XLVI NUMBER 5

MUSCULOSKELETAL REHABILITATION

EDITORIAL

Guest Editorial — *Vernon L. Nickel* 145

ARTICLES

Degenerative Joint Disease — *I. G. Hastie* 148

Restoration of Function at Fracture Site — *P. Bates* 153

Rehabilitation in Juvenile and Adult Amputees — *J. I. D. Main* 156

Chiropractic — *R. Snihura* 162

Low Back Pain

Etiology and Pathogenesis — *Z. Cohen and T. F. Shapero* 166

Classification and Management — *B. Sorokolit* 169

FEATURES

Recent Advances 173

Eponyms and the Men 175

Assaeries 176

Clinico Pathological Conference 177

the UNIVERSITY of TORONTO MEDICAL JOURNAL

Established December 1923
An Undergraduate Publication

Volume XLVI
Number 5
March 1969

editors-in-chief

ABE CHAITON 6T9 — PAUL J. MULLER 6T9

associate editors

R. GORMAN 6T9 and J. D. KEMPSTON 6T9 ..... *Psychiatry*—November

B. LIFESO 6T9 and J. T. MILES 6T9 ..... *Cardiology*—December

H. P. DRUTZ, B.A. 6T9 and K. FOSTER, B.Sc. 6T9 ..... *Obstetrics and Gynecology*—January

A. TOGURI, B.Sc. 6T9 and M. WAXMAN 6T9 ..... *Inborn Errors of Metabolism*—February

R. SNIHURA 6T9 and R. SOROKOLIT 6T9 ..... *Musculoskeletal Rehabilitation*—March

M. ISCOVE 6T9 and E. KEYSTONE, B.Sc. 6T9 ..... *Miscellanea*—April

assistant editors

D. E. GRIESDALE, B.Sc. 6T9 ..... *Recent Advances*

Z. COHEN, B.A. 6T9 and T. F. SHAPERO 6T9 ..... *Symptomatology*

M. GOLDBERG, B.A.Sc. 6T9 and E. B. MEDNICK 6T9 ..... *Clinicopathological Conference*

A. DAVIES, B.Sc. 7T0 ..... *Student Research*

A. J. SHOICHET 6T9 ..... *Assaeries*

G. D. HARDACRE, B.Sc. 7T0 ..... *Eponyms and the Men*

art editor

HEINZ LOTH

business

R. L. WALKER 6T9 ..... *Manager*

advertising

M. S. ROSENBLUTH 6T9 ..... *Manager*

SHERRYN LEVINOFF 7T0 ..... *Accounts Manager*

circulation

BARBARA KEE 7T1

D. SCHACTER 7T1

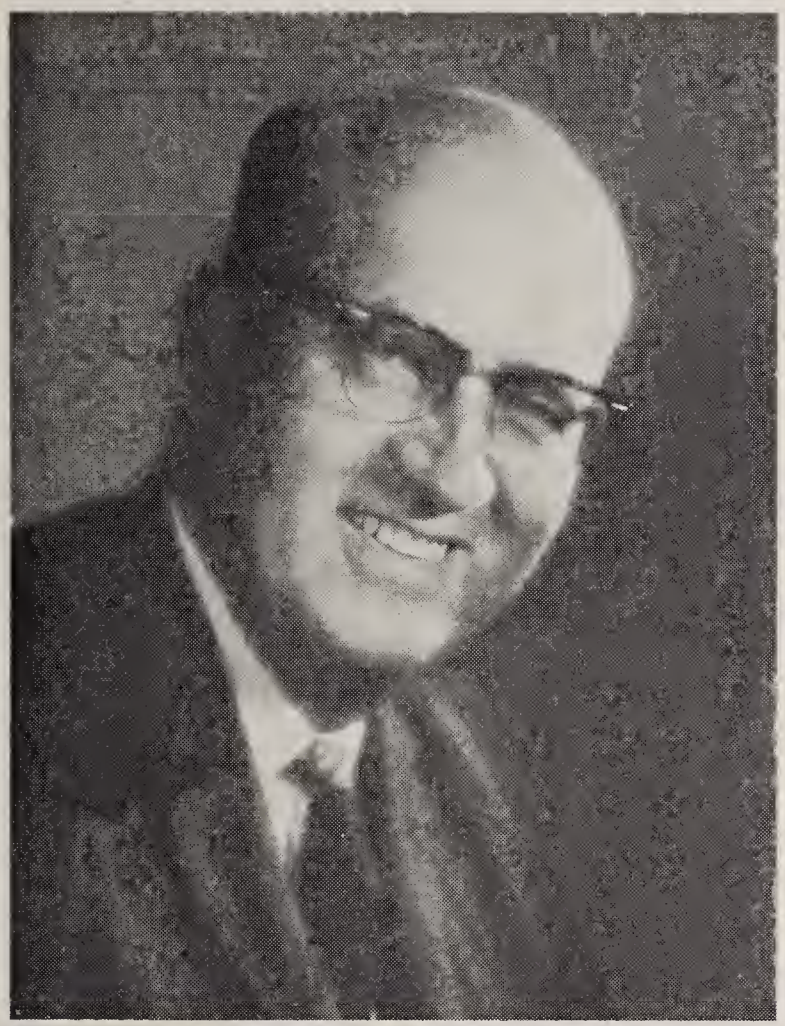
This Journal is published six times a year from November to April, by the Medical Society of the University of Toronto, to serve primarily as a medium for student expression.

SUBSCRIPTION RATES: $5.00 for one volume of six consecutive issues. Single copies, $1.00.

CORRESPONDENCE should be addressed to: **U. of T. Medical Journal, Medical Sciences Bldg., University of Toronto, Toronto 5, Canada.**

Authorized as second class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Printers: Maple Leaf Press, Toronto, Ontario.

Guest Editorial



VERNON L. NICKEL

Dr. Nickel was born 50 years ago in Waldham, Saskatchewan, a small village north of Saskatoon, and thus has strong ties with and feelings for Canada. His parents originally came from the United States, so he had the option of choosing citizenship in either the U.S. or Canada. At the time he graduated from high school in Waldham, the Canadian Depression was in full swing, and it seemed necessary to continue his university education in more prosperous California. His interest in orthopedic surgery was stimulated when he worked as a hospital orderly prior to starting medical school. There he met an outstanding orthopedic surgeon who channeled his thinking toward orthopedics as a career. He graduated from California's Loma Linda University School of Medicine in 1944 and served as a novice orthopedic surgeon with the United States Army. He continued his training in Los Angeles and after this became a Fellow at the Campbell Clinic, University of Tennessee, until he received a M.Sc. in Orthopedic Surgery in 1949. Although he continues in private practice in Los Angeles, Dr. Nickel devotes most of his time to Rancho Los Amigos Hospital in Downey, where he serves as Medical Director and Chief of Surgical Services. This is a large chronic disease rehabilitation hospital which is organized to treat major physical impairments by services which are oriented by disability rather than by specialty. The hospital is affiliated with the University of Southern California School of Medicine, where he is Clinical Professor of Orthopedic Surgery. Dr. Nickel is an associate editor of the Journal of Bone and Joint Surgery and has been appointed to numerous advisory committees such as the American Academy of Orthopedic Surgeons' Committee on Orthopedic Rehabilitation of which he has been Chairman. He was a guest speaker at the Twelfth Annual Symposium on Rehabilitation held in Toronto in October, 1968.

Rehabilitation: The Need For Space-Age Technology

The availability and quality of medical care for acute conditions outstrips the level of care for patients with chronic disorders. We have had to apply most of our knowledge and resources to life-threatening conditions which are urgent and also are most easily treated. However, now that acute conditions are generally well managed, the time has come to bring the same high quality care to chronic disorders. This concept of comprehensive care for chronic disease is included in the broad term "rehabilitation."

Better health care for acute diseases, improved sanitation, and advances in immunology have increased the life expectancy of large segments of the population. The increased numbers of the elderly with their chronic problems as well as the expanding number of young people who survive catastrophic injury and disease are causing greater pressures for adequate care.

Great strides in medicine have occurred as the result of application of modern technology. In acute medicine this can be exemplified through the technology of "magnification" which employed the microscope, the oil immersion lens, and more recently the electron microscope (a Toronto development). Electronics and data processing, space-age innovations, appear likely to improve equally the care of chronic disorders.

To bring appropriate space-age technology to patients with chronic disorders, it is vital to have professional personnel of the same high quality as are involved in acute care. This most certainly begins with the doctor who heads the rehabilitation team. Unfortunately, in the past, the field of "rehabilitation" has not attracted sufficient numbers of the most highly qualified physicians. Teaching concepts of rehabilitation and good models of rehabilitative care leave much to be desired, particularly in the medical schools. It is my impression from a recent visit that the University of Toronto is no exception.

Actually, in Toronto and elsewhere in North America, society is demanding that medical and allied professions improve the total care of patients with severe, permanent physical disability. In Toronto, an example of leadership toward this end has been the support of Lyndhurst Lodge for patients with spinal cord injuries.

This was the first institution of its kind in the western hemisphere in which the efforts of many medical and allied disciplines were concentrated on the treatment of a disability rather than assigning the patient to the management of one individual medical specialty.

Another crucial factor for adequate management of chronic disease relates to the need for wider and more extensive use of the allied health professions. An analogy here would be the use of highly qualified operating room technicians and engineers to assist the skilled surgeon in cardiac operations. The physician in rehabilitation work cannot work alone and he must depend upon the superb professional contributions made by nurses, physical therapists, occupational therapists, speech pathologists, orthotists, prosthetists, and many others to assist him. The rewards and successes to be achieved by learning to work in a multidisciplinary approach to chronic disability can be both a challenge and a satisfaction to the student.

Illustrative of the concept of the breadth of education which a physician should have and one which is dear to the hearts of Torontonians lies in the outstanding work of Banting and Best. It was a pleasure to learn that Banting had originally been trained as an orthopedic surgeon. It is not unlikely that your medical school could well attract other young orthopedic surgeons highly qualified to contribute new and progressive ideas to rehabilitation.

To understand some of the potential of this field, another analogy is in order. The cardiac pacemaker (another Toronto development) is widely used throughout the world to control the neuromuscular function of the heart. Based on the brilliant research in neurophysiology by Eccles and others, the concept of electronic systems to control and probably train other neuromuscular systems appears most likely.

To a limited extent, on an experimental basis, such controls are already being employed to improve function in patients suffering from strokes. Total replacement of arm function in the severely paralyzed patient is now possible, using a tongue control mechanism. At Rancho Los Amigos Hospital we are carrying on research to improve these controls with intra-oral telemetry systems, light-sensitive eye-tracking controls, and myoelectric and neuroelectric controls. Better transportation for the severely physically handicapped may be achieved through use of vehicles such as the Moonwalker which was featured at Ontario's Centennial Center of Science and Technology in May 1967.

The challenges and opportunities in rehabilitation medicine equal and, I believe, surpass most other fields. Highly qualified physicians to implement these ideas are sorely needed. Contributions to rehabilitation can and must be made by physicians in every specialty, as well as those in general practice, but they must understand the concept of the totalness that such an approach to care requires. As is true in most instances when such developments are in their infancy, the rewards of such pioneering and visionary enterprise are infinite.

Vernon L. Nickel, M.D.

Editorial

Musculo-skeletal rehabilitation is a prime example in medicine of the "team-approach", with the doctor as captain. Unfortunately, as a U of T medical student minimal, if any experience along with limited and uninspiring teaching in rehabilitation is generally the rule. Consequently as a physician or surgeon he often may feel incompetent or uninterested in leading this team of physical and occupational therapists, specialized nurses, prosthetists, vocational counsellors and sometimes social workers.

Yet successful rehabilitation requires that the doctor assume full responsibility for directing his patient's care. Besides diagnosis and specific immediate therapy this involves supervising a program to restore the patient to his highest state of function compatible with his physical, emotional and mental potential.

The doctor alone is in a position to understand the physical defect and the restorative potential. And thus he must specifically determine which type of physical therapy is required, how much is necessary and for how long, and when other medical, paramedical or social help is needed. All this time the doctor must continue indoctrinating the patient to help himself when he is not getting physical therapy by following the suggestions of the team, actively exercising, avoiding precipitating factors and maintaining an optimistic outlook. However, with chronic musculo-skeletal problems the therapeutic process for the doctor can fre-

quently be monotonously slow and frustratingly limited compared with the relatively dramatic and controllable drug therapies and surgical procedures available in non-rehabilitation cases.

Physical medicine at one time was a major part of medical practice, but its early unscientific principles and questionable treatments slipped into the shadows of experimental discoveries for acute remediable illnesses. Unsatisfied patients had to grope for quasi-medical relief and incomplete diagnoses from therapists such as osteopaths or chiropractors.

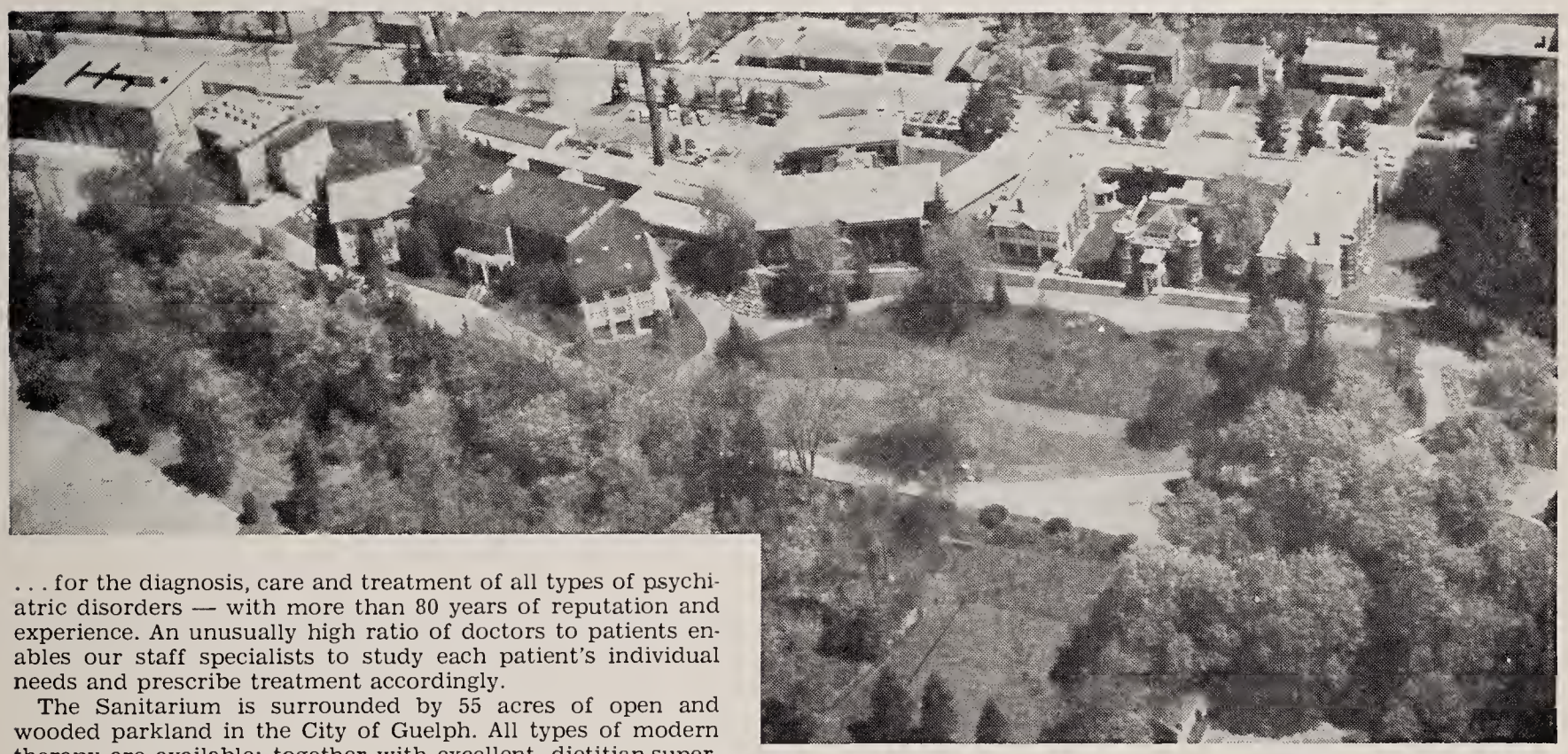
However, currently with adequate control of acute diseases there has been considerable advancement of rehabilitative techniques and development in hospitals of large Departments of Physical Medicine and Rehabilitation with proper personnel, equipment and space. During this progress, Toronto has become well-known for its specialized facilities at the Crippled Children's Centre, the Workmen's Compensation Hospital and the Lyndhurst Lodge Hospital.

Facilities, personnel, equipment, and methods for the rehabilitation team are now available here and rapidly improving. All the patient needs is a physician who is capable, interested and psychologically prepared to be captain of that team.

B. Snihura *B. Sorokolit*

A PSYCHIATRIC HOSPITAL

ESTABLISHED 1883
FULLY ACCREDITED



. . . for the diagnosis, care and treatment of all types of psychiatric disorders — with more than 80 years of reputation and experience. An unusually high ratio of doctors to patients enables our staff specialists to study each patient's individual needs and prescribe treatment accordingly.

The Sanitarium is surrounded by 55 acres of open and wooded parkland in the City of Guelph. All types of modern therapy are available; together with excellent, dietitian-supervised meals; attractive rooms, and personal attention of trained nursing staff.

A large and well-planned building, embracing the latest in modern Occupational therapy facilities, has recently been added. Entertainment, Motion Pictures, Bowling Alleys, Badminton and other Games, are among the Recreational activities being carried on.

Benefits, under Ontario Hospital Insurance and other group insurance plans are available to patients — depending on the nature of the illness and other factors.

For information write, or telephone Guelph 824-1010.

HOMEWOOD SANITARIUM

OF GUELPH, ONTARIO, LIMITED

G. S. BURTON, M.D.C.M. *Medical Superintendent.*

Degenerative Joint Disease - Hip Joint

Ian G. Hastie, B.Sc. 6T9

DEFINITION

Degenerative joint disease (osteoarthritis, osteoarthrosis) is a non-inflammatory disorder of diarthrodial joints, characterized by a deterioration of articular cartilage and by new bone formation at joint surfaces.

INTRODUCTION

To label osteoarthrosis as an inevitable process secondary to "wear and tear" and concomitant with aging is an over-simplification. It should be emphasized that the changes of osteoarthrosis are neither restricted to the elderly nor can a direct relationship between age and severity of cartilage degeneration be demonstrated. While recent studies are not in complete agreement, much information concerning the biomechanics of the joint and the role of cellular enzymes suggests a more precise evolution of the degenerative changes observed in osteoarthrosis.

In "normal" cartilage, approximately 50% of the solids are collagen fibres, the remainder being protein-polysaccharides set within a ground substance or matrix of sulfated muco-polysaccharides (chondroitin sulfate). Classically these fibrils or bundles of collagen have been described as being radially oriented in the form of arcades from the zone of calcified cartilage through to surface layers (Benninghof's arcades). These radial bundles are described as becoming more arched as they approach the surface layers of the joint, eventually becoming parallel to the superficial layer of chondrocytes.

This traditional view has been questioned by some investigators who have demonstrated by electron microscopy that normal joints have wholly unoriented fibres except for the surface layer. Here the collagen is parallel to the surface and presumably contributes to the integrity of the joint. The more radial arrangement is thought to reflect or to contribute to the degenerative process.

The collagen fibrils are in some way linked to the protein-polysaccharide complex of the matrix as complete separation without degradation is impossible. Some experimental evidence suggests electrostatic linkage between the sulfate groups and the areas of high concentration of basic charges on the collagen molecule.

For some time, articular cartilage was thought to be a relatively inert biological substance, with an exceptionally slow metabolism. Newer techniques have shown an average metabolic rate comparable to other tissues, with a turnover too fast to be accounted for solely on the basis of attrition. This implies the existence of an internal remodelling system. Lyosomal bodies in the chondrocytes have been demonstrated with enzymes specific to the protein in the matrix and can ultimately degrade and solubilize the macromolecule.

The nutrition of the articular cartilage is maintained by a diffusion process from the synovial fluid, and to a much lesser extent by diffusion from subchondral vessels. (The latter means is perhaps more predominant where the zone of calcified cartilage is not well developed.) The diffusion and distribution of nutrient is greatly assisted by alternate compression and relaxation, a mechanical pumping with the cartilage resembling a sponge. Intermittent compression is to the fluids of the joint cartilage as pumping by the heart and peripheral tonus is to the systemic cirulation.

PATHOGENESIS OF ARTICULAR CHANGES

The fundamental lesion of osteoarthrosis is a softening of the matrix of the articular cartilage related to a reduction of chondroitin sulfate and an alteration of the ultra-structure of the protein polysaccharide complex.

With any functional anatomical or pathological change at or across the joint surface, the alteration in articulation results in new areas of weight bearing and sustained compression. It is important to keep in mind the dynamic aspects of this change as it is the combination of alternating compression and relaxation with even distribution of force which provides maximum efficiency for the nutritive process. Experiments have shown that continuous compression of articular cartilage results in the lesion of compression necrosis caused by an interference in the diffusion of synovial fluid through the cartilage matrix. This nutritive interference results in the death of chondrocytes and the process of chondromalacia. The release of specific proteolytic enzymes from the lysosomes of the dying chondrocytes results in the degradation of the protein polysaccharide chains and probably changes the cohesive electrostatic forces between the collagen fibres and the matrix. Histologically there is a progressive re-orientation of collagen fibres in a more radial manner (i.e. perpendicular to the surface) with a reduction of chondroitin sulfate in the ground substance. It seems that the re-orientation of fibrils is due to tensional forces across the joint.

The softened, rearranged cartilage is now ripe for the changes of osteoarthritis. Tensional joint stresses cause a dehiscence of cartilage along the planes of the collagen fibrils. When confined to the surface layers this process is one of flaking. However, with the increasing predominance of more radially arranged fibrils, cleavage exposes the deeper transitional zones of cartilage and fibrillation occurs; that is, vertical dehiscence. This process is thought to be aided or accelerated by a penetration of joint hyalu-

ronidase into deeper zones with increased degradation of matrix polysaccharide. In any event, the forces acting on the greatly weakened cartilage lead to progressive destruction and eventual erosion to subchondral bone.

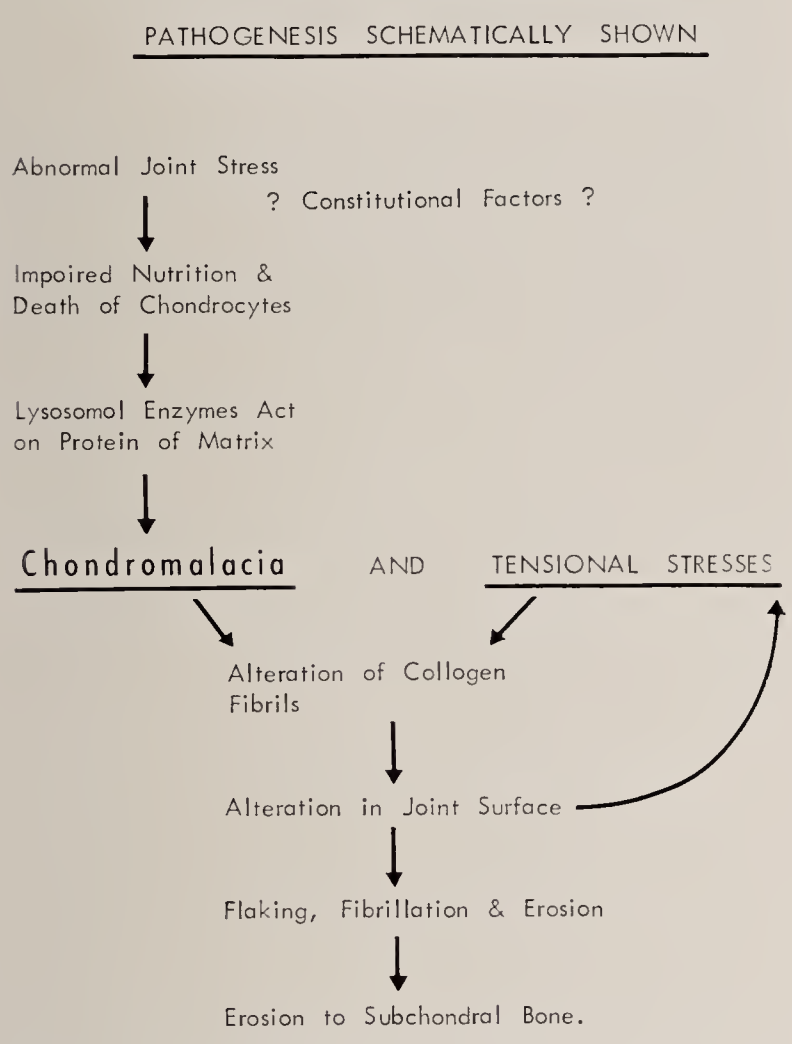


FIG. 1. Pathogenesis of articular cartilage destruction beginning with abnormal joint stress.

PATHOGENESIS OF BONY CHANGES

As a reaction to cartilage destruction, repair is attempted and subchondral vessel proliferation occurs with hypervascularity of bone. The alteration in the dynamics of joint stresses results in an extension of vessels and cartilage in the non-weight bearing areas (i.e. the joint periphery) and the bone and marrow of the osteophyte is laid down. In weight bearing areas the bone becomes dense and sclerotic. However, the recurrent excessive attempts at repair further weaken and reduce bone strength by virtue of accompanied hypervascularity. The new bone formation may further reduce total pressure distribution and so affect joint biomechanics that fracturing and buckling of the underlying bony trabeculae may occur. These necrotic areas of bone characteristically form bone cysts. Continuity between the joint space and the cyst results in pressure transmission and further enlargement of the cyst. Where articular erosion to subchondral bone has occurred, the surface becomes smooth and polished; this is the process of eburnation.

SYNOVIAL CHANGES

The synovial changes in osteoarthrosis are usually minimal, particularly in comparison with the florid changes of rheumatoid arthritis. The presence of "loose bodies", fragments of articular cartilage, in the joint may excite an inflammatory response in adjacent synovium and produce some fibrosis and scarring with further restriction of joint mobility. However, these changes are more likely to be a source of pain rather than restriction. In long standing osteoarthrosis there is frequently villous hypertrophy of the synovium. Arthroscopy of the knee joint has revealed more severe changes of traumatic synovitis and villous hypertrophy than previously thought. Such may also be the case with osteoarthrosis of the hip.

PATHOGENESIS OF SYMPTOMS

Osteoarthrosis probably remains asymptomatic for a considerable length of time. Radiological demonstration of joint changes will inevitably follow physical symptoms, of which pain is probably the earliest manifestation. There are four sources of this pain:

1. Traumatic synovitis
2. Muscle spasm
3. Hyperemia of juxtachondral bone
4. Bone grating on bare bone.

CLASSIFICATION

Traditionally osteoarthrosis has been differentiated into primary and secondary disease types. Primary osteoarthrosis is thought to be linked to a single autosomal gene and to be sex-influenced: dominant in females and recessive in males. While some studies have questioned the concept of generalized osteoarthrosis, the constellation of Heberden's nodes, degenerative changes in the distal and proximal interphalangeal joints, and in the metacarpal-carpal joints (particularly of the first ray), and arthritis of the cervical spine is a common entity and probably represents a hereditary pattern.

Secondary degenerative disease is accepted as that having some previous pathology, either anatomical or functional in nature. It is perhaps most advantageous to classify osteoarthrosis of the hip on the basis of morphological change as there are three recognizable patterns.

1. Idiopathic-mechanical (see fig. 2)

Radiologically there is a destruction of the weight-bearing areas with a migration of the femoral head superiorly and laterally. This type of degeneration probably follows functional abnormality in the joint, and anatomical change secondary to trauma (i.e. joint and acetabular fractures). Postural deformity secondary to gluteus medius paralysis or significant leg-length discrepancy predisposes to this type of degenerative change, the latter in 80% of cases.

2. Secondary to Inflammatory or Metabolic Disease (see fig. 3)

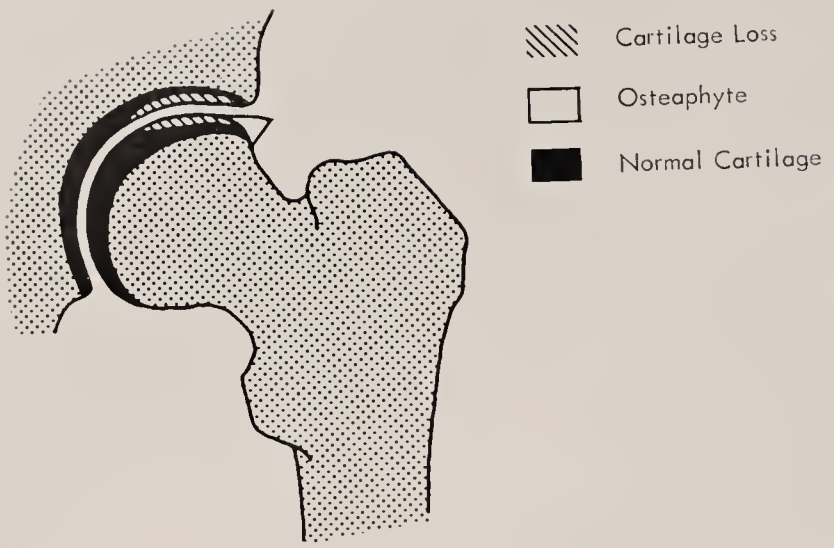


FIG. 2. Idiopathic - mechanical osteoarthritis — destruction of weight bearing areas of articular cartilage.

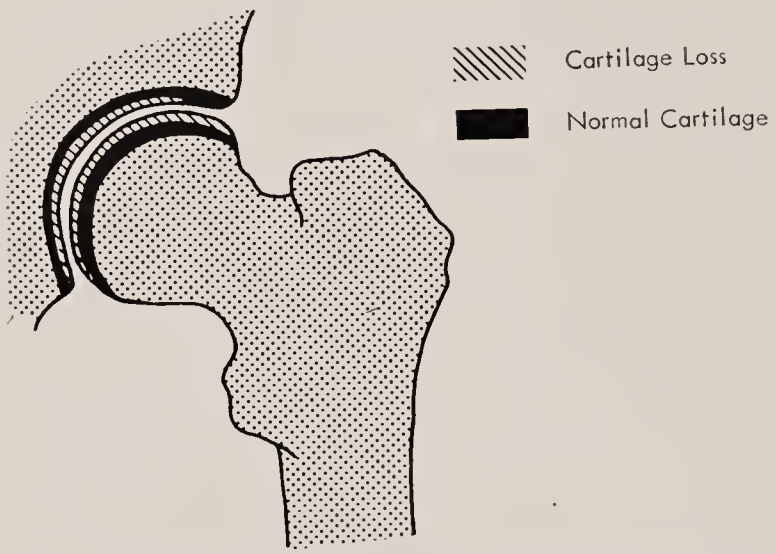


FIG. 3. Osteoarthrosis secondary to inflammatory and metabolic disease — uniform and circumferential loss of articular cartilage.

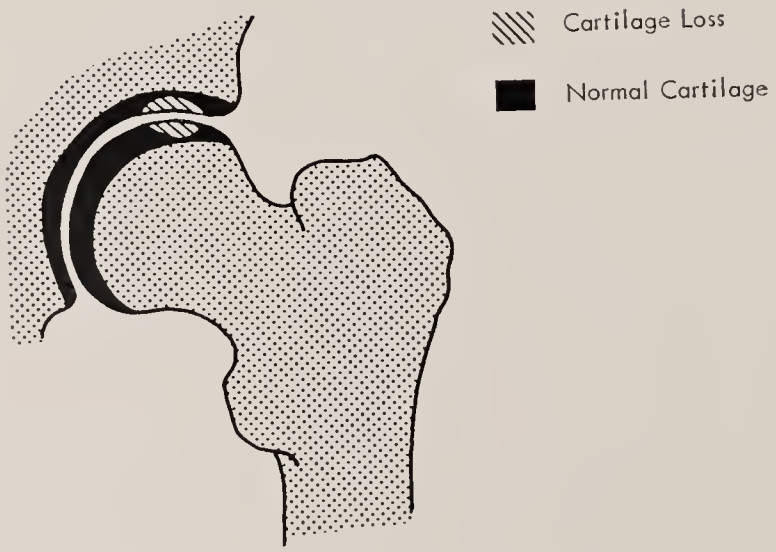


FIG. 4. Osteoarthrosis secondary to vascular necrosis of femoral head — segmental erosion of articular cartilage.

This involves uniform circumferential loss of articular cartilage with movements of femoral head superiorly and medially. Such conditions would include postmenopausal arthritis, acromegalic arthritis, that following excessive steroid therapy, and osteoarthrosis secondary to other arthritides — rheumatoid and pyogenic arthritis and gout.

3. Secondary to Avascular Necrosis of the Femoral Head with Segmental Erosion of Articular Cartilage. (see fig. 4)

4. Miscellaneous

This would include other conditions affecting the joint and which are more non-specific in destruction, i.e. coxa vara and other developmental diseases such as congenital dislocation of the hip and anteversion and valgus of the femoral head. The radiological changes are defined under diagnosis.

DIAGNOSIS

I HISTORY

1. Age — usually greater than the fifth decade
2. Sex — slight female predominance
3. Onset — insidious, with no systemic manifestations
4. Symptoms
   - (a) Pain
     - — after a night's rest
     - — worse with activity
     - — as high as fifty percent may have pain referred to knee, superior to patella or superior to the joint cavity
   - (b) Stiffness — after rest
   - (c) Deformity — limp - of several varieties - with increasing severity of the degenerative process, the following become manifest:
     - (1) Gluteus medius limp — minimal rolling gait
     - (2) Trendelenberg droop of the pelvis
     - (3) Hip flexion with lordosis
     - (4) Lumbar gait of total ankylosis
   - (d) Giving Way
     - — from sudden pain
     - — nipped synovium
     - — loose body or osteophyte

II PHYSICAL SIGNS

1. Usually one hip involved
2. Minimal muscle waisting and spasm
3. Position of flexion, adduction and external rotation is most comfortable. There will be restriction or increase in pain with opposite movements, i.e. external rotation, extension and abduction.
   Flexion deformity is best measured by a line passing through anterior and posterior superior iliac spines and a second line dropped from the midpoint along the length of the femur. The deformity can then be measured in degrees most accurately.
4. No warmth or effusion.
5. Crepitus is common.

6. Apparent shortening of the affected leg (may be actual shortening).
7. Head of femur may feel larger on palpation and further back.

III LABORATORY FINDINGS

These are almost always negative in all respects unless there is co-existing inflammatory disease. Occasionally the cholesterol may be elevated. The E.S.R. may rarely be as high as fifty to sixty though this is not always the case. In older individuals the normal sedimentation rate may be in the high twenties and this must be recognized.

IV RADIOLOGICAL FINDINGS

1. diminished joint space
2. sharpened articular margins
3. osteophyte formation with bone lipping
4. thickened subchondral bone
5. cystic rarefaction
6. flattening of femoral head.

PREVENTION AND MANAGEMENT

Perhaps the most important aspect of treatment involves an accurate classification and diagnosis. Should some systemic disease be contributing to, mimicking, or causing the degenerative condition and be overlooked, the results will be traumatic both to physician and patient. One must beware of the possible coexistence of metastases, myeloma and osteoporosis. The choice of treatment then depends on the severity of the disease, the extent of the disability, and the age and occupation of the patient.

Traditionally, the lesions of osteoarthrosis have been held to be irreversible, and treatment was directed at relieving pain, maintaining mobility, and preventing progressive joint degeneration. In examining this premise, it is worthwhile to note that following osteotomy for degenerative disease there is occasionally a resolution of cysts and osteophytes, and an increase in the joint space suggesting articular cartilage regeneration.

With the pathogenesis of the degenerative process in mind, a general principle in management can be stated: "The anatomical and biochemical function of the joint should be redressed with the aim of preserving joint cartilage."

GENERAL MEDICAL TREATMENT

1. *Weight reduction in the obese.* While animal experiments do not support the correlation between obese strains and degenerative disease, it seems logical to argue that degree of cartilage compression is a function of force acting per unit area in the given time. Reduction of one of these parameters improves the biomechanics of the joint.

2. *Rest and protection from excessive stress and strain.* This is most important in the acute phase of the disease where excessive pain and muscle spasm precludes the proper mechanical function of the joint.

3. *Physiotherapy.* Exercise is of prime importance because joints may be kept free only by movement. Repeated sessions of joint activity in order to exert the full range of movement ought to be performed every four hours daily. The aim is also to strengthen muscles and ligaments that correct the deformity without exaggerating any synovitis. A cane may greatly diminish strain but crutches or a walker can be used if necessary. Heat will help in relief of muscle spasm and pain. Infra-red heat or moist heat probably gives maximum benefit.

4. *Analgesics and anti-inflammatory agents.*

Systemic steroids are contraindicated. Intra-articular steroids are often of benefit in degenerative disease especially when pain is not relieved by salicylate therapy. Relief from pain may last for months though response of the patient is variable. Salicylates are the drug of choice and produce maximum benefit in the milder cases. Dosage is usually four to six grams daily. Blood levels are the most effective means of checking doses and should be maintained between 20 and 30 mgm%. Propoxyphene may be used to help relieve persistent pain.

Indomethacin though reported to relieve pain of degenerative hip disease has serious limitations because of toxicity. Phenylbutazone dosage is usually 100 mgm three times a day. Bone marrow depression is rare. Phenylbutazone may be tried if salicylates are unsuccessful though usually the degenerative process requires more aggressive therapy at this stage.

SPECIFIC MEDICAL AND SURGICAL TREATMENT

Practically, management is best divided into three stages.

Stage 1: *Minimal to moderate osteoarthrosis.*

1. Physical examination. Record accurate measurements of leg length, presence of deformities and range of movement. Correction of leg length discrepancies is attained by using built-up heels. A cane to relieve pressure on the affected hip is most important as gluteus medius contraction greatly compresses the femoral head in the acetabulum adding to force transmission and degeneration.

2. Analgesic Therapy — salicylates. Routine checks on salicylate levels can be done on an out-patient basis if necessary.

Stage 2: *Moderate to severe osteoarthrosis.*

1. Hospital admission.
2. Intra-articular steroid injection (most accurate under x-ray).
3. Relief from weight-bearing for at least one week, preferably two, to allow the pain to subside. This usually

decreases bone hyperemia, traumatic synovitis and muscle spasm.

4. Recheck salicylate levels if necessary and continue maintenance therapy with salicylates.

Stage 3: *Surgical: Incapacitating Osteoarthrosis*

When the hip joint shows progressive deterioration of joint space, progressive deformity and pain despite medical treatment, surgical relief may be considered. Significant deformity without pain may be an indication for surgical intervention, but the choice of treatment must always be individualized depending on age and occupation of patient.

1. Joint excision — Girdlestone procedure. This is primarily of historical interest as removal of the femoral head and neck leaves a weak and unstable joint. It is seldom used.

2. Arthrodesis — Surgical ankylosis removes pain but throws additional strain on the remaining joints and may predispose to degenerative disease in other areas. Occasionally arthrodesis fails and results in a functional arthroplasty. It can be converted to arthroplasty by a second operative procedure.

3. Osteotomy — Osteotomy is an effective operation for relief of pain where range of motion is not a problem. The alteration in the weight-bearing lines of function through the joint reduces ligamentous and muscular strain, and the cutting of the bone reduces hyperemia.

4. Arthroplasty — There are two main types:

(a) single — replacement of the femoral head with a Moore-type prosthesis. This does not alter or repair any co-existing acetabular destruction;

(b) acetabulum and head of the femur — in theory this type of prosthesis appears superior to other modes of surgical treatment. The biomechanical and antomical functions of the joint are redressed with good range of motion. With present development of new acrylic plastics and bone glues the conventional cup arthroplasty has become outmoded. Post-operatively convalescence is short, with weight-bearing being possible in two or three weeks. This reduces morbidity in the elderly and yet provides a good functional joint, making it the procedure of choice in a younger individual.

SUMMARY

While some evidence of a familial tendency to cartilage degeneration exists, much investigation is needed to clarify the genetic elements of degenerative joint disease. To classify it as a deterioration with mechanical, dystrophic and genetic elements is acceptable, but to label it inexorably as progressive is to be unduly pessimistic. Further studies will undoubtedly resolve some of the controversy regarding etiology and add further information regarding therapy.

ACKNOWLEDGEMENT

Many thanks to Dr. Hugh Smythe, Wellesley Hospital, for his time and help in preparing this article.

REFERENCES

1. Arthritis and Allied Conditions. J. L. Hollander, 1966.
2. Bulletin on the Rheumatic Diseases. Vol. 14, No. 1, Sept. 1963; Vol. 14, No. 6, Feb. 1964; Vol. 17, No. 7, March 1967; Vol. 17, No. 9, May 1967; Vol. 18, No. 4, Dec. 1967; Vol. 19, No. 1, Sept. 1968.
3. The Hip, F. G. St. Clair Strange, William Heinemann Medical Books Ltd. 1965.
4. Journal of the American Physiotherapy Assoc. Vol. 44. No. 7, July 1964.
5. Journal Bone and Joint Surgery, Vol. 40-B, Feb. 1958; Vol. 42-A, 1960; Vol. 42-B, Aug. 1960.
6. Studies of the Development and Decay of the Human Frame. J. Trueta. William Heinemann Medical Books Ltd., 1968.
7. Textbook of Rheumatic Disease. Copeman, 1964.

"Thought for the Day..."

Why take chances on your future insurability? If you are a young man in good health, you can guarantee that insurability. Why not call me today and ask for full particulars on Sun Life's *GUARANTEED INSURABILITY BENEFIT?*

JOSEPH RACCO
TORONTO EGLINTON BRANCH
120 EGLINTON AVE. EAST., TORONTO 12, ONT., TEL.: 487-5531

SUN LIFE OF CANADA

Restoration Of Function At Fracture Site

Paul Bates, B.Sc. 7T0

INTRODUCTION

The patient with a limb fracture judges his treatment by:

1 — cosmetic appearance of the fracture area
2 — restoration of function
3 — inconvenience during treatment

Accordingly, treatment of fractures should be directed to attain the best possible results in these three areas.

Immediate treatment:
1 — assessment
2 — debridement
3 — reduction
4 — immobilization

Follow-up treatment:
1 — post-operative care
2 — remodelling of site
3 — restoration of function of immobilized and non-immobilized joints

FRACTURE TYPES

With fractures, the evaluation of the location, type, displacement and degree of comminution is important in treatment, for these characteristics determine the most suitable means of immobilization. Transverse fractures are suitable for conservative treatment since they seldom re-displace after reduction. Conversely, a spiral fracture or an oblique fracture will likely redisplace unless jagged edges of bone lock the fragments in place. Comminuted fractures are more difficult to immobilize. Crush fractures of spongey bone are also a problem because the resulting powdered form of the fracture does not lend itself to anatomical reduction. When the skin is broken, the chances of infection are greatly increased; therefore, the base of the wound must be thoroughly debrided.

Another consideration is the alignment of the fragments, since this determines whether open reduction is necessary or whether it can be accomplished by simple manipulations. If the fractured bone is near the skin surface, as is the tibia anteriorly, management is easier than for fractures of a more deeply situated bone, such as the femur.

Some bones are so positioned that a fracture does not require fixation for proper healing. A circular bone, such as the pelvis, is stable enough to support one fracture line without fixation. Fractures near joints have the disadvantage of possible involvement of joint structures with resulting damage to, or irritation of, the joint. Finally, the precarious blood supply of parts, such as the femoral head or lower tibia, is a concern in treatment.

PATHOLOGY OF DYSFUNCTION

Trauma and subsequent treatment at the fracture sites produce ideal conditions for pathology leading to dysfunction. The original injury may:

1 — introduce infection
2 — leave an irregular joint surface
3 — tear supporting structures of the joint

Treatment and healing may:

1 — form scar tissue at inappropriate positions, limiting joint mobility;
2 — produce a restrictive fibroplasia by constant bathing of the tissues in stagnant edema fluid. This stagnation is the result of absence of muscle contractions during immobilization thus preventing reduction of swelling. Normally, muscle contraction acts as a pump to assist lymphatic and venous return. A recurrent edema may also form after a cast is removed. This edema appears to be affected by gravity and results from the failure of adequate fluid circulation.
3 — tear the capsule or soft tissues if an overly enthusiastic therapist forcefully manipulates a joint (especially when the fracture site has been anaesthetized).

Not only do these occurrences produce joint dysfunction but the distorted outline of an inflamed or weakened joint leaves a constant physical reminder of the trauma and treatment associated with the fracture.

EXTERNAL FIXATION

The traditional treatment of fractures around joints has been the use of skin-tight or padded casts. In this method open reduction is used only with failure of closed manipulation, redisplacement or infection. Bohler[1] describes the treatment as a skin-tight plaster, allowing no joint movement but placed in a position of function. Static exercises of the enclosed muscles reduce stasis of fluids. It is now considered that padded plasters act better to minimize edema of the limb after the fracture site loses its edema. This method follows the criteria of:

1. alignment of bones
2. immobilization allowing healing
3. movement of the fracture site as a unit
4. minimal trauma to the fracture area

Modification of plaster fixation now allows application of traction or even compression to aid healing. Danis[2] suggests that compression of bony fragments might be an aid in osteogenesis since opposed or irritated surfaces are prone to bony calcification. Charnley[2] agrees that

joints such as the knee produce osteogenesis by apposition but he could find no evidence of this reaction at fracture sites. Indeed, Watson-Jones[2] even speaks of an increased stability but destructive action on healing. Recent work on early weight-bearing with fractured tibias[3] substantiates the theory that controlled compression does aid union and produces only moderate shortening. Compression is also used to oppose widely separated fragments. Traction exerts its beneficial effects by preventing muscular distortions, maintaining the fracture in a position of alignment and serving to minimize shortening of a limb.

The treatment of fractures with a plaster cast requires rest, resulting in what Muller terms "Fracture Disease".[4] The common complications of external immobilization are:

1. necrosis of skin, due to pressure
2. increased distal edema caused by obstruction
3. unrecognized arterial or nervous block
4. prolonged bed rest leading to bone decalcification, urinary incontinence, venous thrombosis and mental depression
5. failure to stabilize the bony parts when there is a large overlying thickness of soft tissue.

INTERNAL FIXATION

Internal fixation is widely used in Europe but is used more cautiously in North America. Exponents, such as Muller, feel that internal fixation is better able to provide a stable fracture site since the bony parts are used to support the area. Additional benefits are that the skin surface is visible so edema or infections are better observed and controlled and earlier movement is possible.

The air of caution results from complications of surgery:

1. increased risk of embolism
2. danger of sepsis is magnified
3. increased frequency of non-union with internal fixation, possibly due to periosteal stripping, bone necrosis, nail slippage, decreased medullary callus formation or embarassed medullary circulation.

The indications for internal fixation are:

1. inability to obtain and maintain adequate position by other means
2. pathological fractures in the hope of restoring some function by internal fixation
3. desire for earlier mobility and better immobilization

The last indication has a wide range of interpretations. Generally, this method is reserved for the neck of the femur, fractures of both the tibia and fibula, and fractures of terminal styloid processes. In these fracture types, internal is more effective than external fixation. More enthusiastic advocates of this method, such as Kuntscher[5], would pin "all cases in which a stable osteogenesis can be achieved". This includes transverse fractures of the midshaft of long bones and comminuted fractures of the upper limb after amputation where shortening is not a problem. The advocates feel that callus formation is a pathological reaction and that their opposition can be so good that callus formation is avoided and healing can be achieved by "first intention" between the fracture fragments. Thus the complication of decreased intramedullary callus is minimized. Internal fixation is seldom used in areas of conical bone where stabilization is quite difficult. Studies by Bohler and Habler[5] indicate a shorter term and less work loss with femoral shaft fractures treated with internal fixation.

Table 1. An Analysis of Treatment and Results

Treatment	Average length of treatment (days)	Average number of work days lost	% permanent disability pensions
Plaster of Paris and traction in hospital	240	627	10.2%
Plaster of Paris without hospitalization	390	1819	22.6%
Intramedullary nailing	53	97	0 %

Although advocates of surgery obtain good results with internal fixation, the majority of researchers, while citing the fact that internal fixation was often reserved for more difficult patients, have found a clear indication of better results with conservative treatment.

Barrington and Dewar,[6] studying tibial plateau fractures, found these results.

Table 2. Conservative vs Operative Treatment Results in Tibial Plateau Fractures as Judged by Barrington and Dewar.

	Total	Excellent	Good	Fair	Poor
Number of cases	65	13	19	25	8
Conservative	41	11	12	13	5
Operative	24	2	7	12	3

The strong predominance (62.5%) of fair or poor results with operative treatment compares less favourably with the 44% of similar results with conservative care.

Burwell and Charnley[7] found that internal fixation, when it remained intact, produced results favourable with closed treatment in forearm fractures in adults. In this series a plate was used on the forearm; plates shorter than 3½ inches had a 37% rate of non-union while plates longer than this had a 5% rate of failure.

The movement now has progressed to the point of modification of the two methods to suit the individual case. Internal fixation proponents have devised many new types of nails, plates and sliding pins, all intended to excel in certain fractures. In addition, efforts to obtain

internal fixation with minimal operative procedure are being investigated. The image intensifier allows external observation of the site during nailing thus minimizing surgical trauma to the area.

POST-OPERATIVE MOVEMENT

External fixaxtion, too, has been changed to prevent its traditional problems of immobility and resultant stiffness. Currently, many surgeons are advocating immediate post-operative movement and weight bearing, feeling that mobilization of the injured part as soon as possible is the only sure way of minimizing permanent stiffness. However, Charnley[1] states another idea in his Law of Closed Treatment:

> "After fractures of the shaft of a long bone, the associated joints will tolerate fixation for the duration of normal union without either permanent or significant loss of motion."

Charnley is unimpressed by ideas that a few degrees of joint movement after a few days can aid the return of a normal range of movement many months later. The problem, in his opinion, is to prevent complications. His claims are substantiated by the majority of fractures which, after enduring an uneventful but lengthy period of immobility, effectively regain complete function.

American army surgeons,[3] working with tibial shaft fractures in well-conditioned men, treated them with a toe to groin cast, the knee extended, and walking the next day. In 400 fractures, they reported no non-unions over an average healing time of 14.7 weeks; however, 3.5% of the patients experienced leg shortening and, although many of these people had been early candidates for amputation, many centres are not prepared to accept this rate. Additional work by Sarmiento[8] with below knee casts for tibial fractures shows similar results.

In this currently unresolved problem, we must not forget the boost to patient morale accompanying early movement. Morale cannot be measured quantitatively, but is certainly a consideration in full treatment. This method appears to represent a compromise between the traditional conservative type of external and operative internal fixation.

PHYSICAL THERAPY

The natural hesitancy of patients to use a limb which has been painful and which may have been distorted often requires that special exercises be used to initiate movement. There is danger in using passive movement to exercise the fracture area, for, if nerve damage with resultant anaesthesia has occurred, damage to soft tissue or to the fracture site may be done. In addition, the patient is missing the psychological lift of using his own injured limb, and the physiological pumping mechanism which circulates blood and reduces edema.

Often the first exercises can be undertaken best in a warm pool, the warmth stimulating circulation and relaxing the patient, the water buoyancy preventing sharp painful movements and allowing the patient to relax his tension on the limb.

Another method of acquiring movement in a tense patient is by "gravity movements". If an arm is hanging vertically, the effect acquired by bending at the waist is equal to lifting the arm to shoulder level. This, however, is a passive movement and does not give all the advantages of active motion. If the active motion is not attained, the muscle pumping action may be replaced by massage of the area, forcing edema out of the region.

The theory behind mobilization is to encourage all active movements which the patient can perform, especially those which he will need in his normal activities.

If movement is impaired by inflammation, Butazolidin, Tandearil, or acetylsalicylic acid will assist in restoration of function by reducing the inflammation.

CONCLUSION

This article has viewed fracture treatment in terms of total rehabilitation. Several points have been established:

1. The type of injury involved usually dictates the type of treatment to be used.
2. Complications of treatment are the most common causes of failure of treatment.
3. Internal and external fixation both produce success in selected cases. Internal fixation has a greater variety of complications but certain fractures are better suited for this treatment.
4. Compression, traction, and early mobility all have value in fracture treatment.
5. Intelligent use of physical therapy can attain limb action in a patient with a fracture.

With proper use of the variety of methods available, fracture treatment can be successful cosmetically and functionally with minimal inconvenience to the patient.

ACKNOWLEDGEMENT

The author wishes to thank Dr. T. A. Wright, of Toronto Western Hospital, for his assistance with the preparation of this article.

REFERENCES

1. Charnley, Closed Treatment of Common Fractures. 1963.
2. Watson-Jones, Treatment of Fractures. Vol. 1, 1957.
3. Kris, Loeser, Dehne, Immediate Weight Bearing as Treatment of Tibial Shaft Fracture, J.B. & J.S., 47A 1085, 1965.
4. Muller, Allgower, Wellenegger, Technique of Internal Fixation of Fractures. 1963.
5. Kuntscher, Practice of Intramedullary Nailing. 1967.
6. Dewar and Barrington, Tibial Plateau Fractures, Canadian Journal of Surgery 8: 146-152, April 1965.
7. Burwell and Charnley, Plating of Forearm Fractures in Adults, J. B. & J. S. 46B: 404, 1964.
8. Sarmiento, A Functional Below the Knee Cast for Tibial Fractures, Journal of Bone and Joint Surgery 49A: 855, 1967.
9. Krussen, Handbook of Physical Medicine and Rehabilitation. 1965.

Rehabilitation In Juvenile And Adult Amputees

J. I. D. Main, 6T9

The loss of any portion of a limb disables the individual to a variable degree depending on the level of amputation, the age of patient, and the post-operative management. With proper rehabilitation, however, most patients can be restored to a useful role in society.

The problem is completely different in adults and children — both in types of amputation seen and in response to rehabilitation measures; this will be discussed further in the article.

INDICATIONS FOR AMPUTATION

The four most common indications for amputation are:

(1) destruction of a limb (traumatic);
(2) loss of blood supply (gangrene);
(3) malignant tumour with hope of eradication;
(4) congenital deformities.

Fifty percent of children seen in a children's amputee clinic have congenital amputations which require no further surgery. But fifteen percent of children seen have congenital appendicular abnormalities best treated by conversion to an amputation.

Other indications are (5) irremediable pain of circulatory origin, (6) uncontrolled infection, (7) cosmetic reasons and (8) paralysis.

The main function of the lower limb is weight bearing, and for this, stability, muscle power, joint motion and length are necessary. Since prehension is the principal function of the upper limb, fine movement and coordination must be retained. Therefore prosthetic replacement of an upper extremity is not as satisfactory as that of a lower extremity. One tends to preserve as much of the upper limb as possible, since even the most grossly deformed or shortened arm is of greater service to the patient than any artificial appliance.

TYPES OF AMPUTATION

There are two main types of amputation:

(1) *the open (guillotine) type* is temporarily left open for the control of infection as a life-saving procedure. This is the type of amputation which is done on the battlefield. The surface of the wound is not covered with skin, but is left open to facilitate drainage. This type must always be followed by a formal revision at a higher level;

(2) *the closed type* is a definitive amputation with full skin closure to create a stump which may be used effectively with a prosthesis.

Speed is no longer an essential factor. Now, use is made of myoplastic techniques and, experimentally, of silastic plugs in the medullary cavity.

SITES OF AMPUTATION

An amputation may be considered at any site, but there are certain factors which determine the level of amputation:

(1) adequacy of circulation;
(2) sensation above the amputation site;
(3) function of the part;
(4) type of prosthesis;
(5) muscle balance.

The greatest factor in the use of prostheses is the presence of a knee or elbow joint. All effort should be made to save these joints.

A. Lower Extremity

(1) through the foot

a) toes

b) transmetatarsal. These amputations are a minimum handicap which require no prosthesis and cause little additional contralateral limb strain.

(2) Syme's amputation. This is the most satisfactory amputation of the leg and is indicated in severe foot injuries, in intractable foot infections and in certain obliterative vascular conditions.

The amputation is done through the ankle with the heel flap brought over the tibia. This is an end-bearing stump with superior function since skin accustomed to weight bearing covers the end.

Syme's amputation can be used in children, especially in destructive foot injuries and in certain congenital foot deficiencies and deformities. It has two special advantages not applicable in adults. Since the epiphyseal plate is preserved, growth of the limb is not diminished. Secondly, progressive growth does not project the bones through the skin, as happens too frequently when the amputation is through the shaft of the tibia.

(3) Below the knee. This site is used if

a) there is some hope of rehabilitation;

b) there is good bleeding at the amputation site with contractile muscle at that level and warm skin extending down to the middle of the leg.

(4) Knee disarticulation. This is a useful procedure in children since it results in an end-bearing stump which

will grow in proportion to the other femur. The only disadvantage is trying to fit a knee mechanism prosthesis which will remain in close contact with the stump.

(5) Above knee. As much femur as possible should be preserved because the difficulty in prosthesis fitting is proportional to the shortness of the stump. This level of amputation is necessary when circulation is poor. The junction of the middle and lower third is the preferred site.

(6) Hip Disarticulation. This is almost never indicated. Even a small stump of bone should be left and is useful for grasp by the contours of the socket. A smooth contour of the hip is useless for controlling the artificial limb.

(7) Hindquarter amputation. This is the removal of the entire lower extremity and the corresponding half of the pelvis, and is done only for malignancy with some hope of eradication.

B. UPPER EXTREMITY

(1) Fingers. The thumb is the most important digit. All possible length is preserved, by orthopedic reconstruction if necessary. If the thumb is short, deepening the web between the index finger and the thumb improves the grasp.

(2) Wrist disarticulation.

(3) Forearm. The distal one-third is unsuitable as the amputation site since the underlying tissues are largely tendinous, the skin is thin and the stump tends to become cold and cyanotic. The ideal level is the junction of the middle and lower thirds. As much length as possible is preserved in order to retain pronation-supination of the forearm.

(4) Elbow disarticulation.

(5) Upper arm. The supracondylar region is the ideal site. A stump of two inches or less is of no functional value but should be preserved to maintain the contour of the shoulder.

(6) Shoulder disarticulation.

(7) Forequarter amputation.

TYPES OF PROSTHESES

A. Upper Extremity Prosthesis

The type commonly in use is the forearm prosthesis, consisting of a plastic shell which fits over the forearm. The sides are supported by steel bars which pass upward to the elbow and are fixed to an upper arm cuff. Distally, the bars are attached to a socket in which the artificial hand or hook is mounted. (Metal side bars are now replaced by soft Dacron hinges which give much more mobility.) Activation of the artificial hand is effected by a cable extending to a cuff around the opposite shoulder.

At present, there is a great deal of research being done in prosthetics. Appliances powered by gas or by myoelectric potentials may soon replace the standard appliance mentioned above.

B. Lower Extremity Prosthesis

There are five different types:

(1) end-bearing;

(2) patellar-bearing;

(3) total contact;

(4) suction socket;

(5) ischial brace.

Research in lower extremity prosthetics suggests that the most beneficial procedure for the patient is application of the prosthetic immediately after or even during surgery. The prosthetic used is the total contact type in which weight is distributed evenly and which allows the patient to begin ambulation almost immediately.

REHABILITATION OF THE AMPUTEE

Following the amputation of an extremity, the patient is faced with many new problems which may be unrelated to his basic disease. Obviously, if he has lost a hand, he will be unable to do routine bimanual tasks. The amputee may also feel mutilated and find interpersonal relationships embarrassing and difficult. Furthermore, it may be impossible for him to return to his job, and financial worries may add to his other burdens.

Although most other surgical patients are able to return to their former lives, amputees often cannot. The amputee, his self concepts, and his ability to function in the world about him have been altered. Therefore ensuing rehabilitation must include attention to the whole person and his total environment.

Immediate Fittings of Prosthesis

An important part of this rehabilitation is the early fitting of the prosthesis following amputation, especially in the lower extremity. The very early or immediate application of prosthetic components to lower amputation stumps is a relatively recent concept.

Except in the case of an emergency traumatic amputation, the procedure begins pre-operatively with the medical evaluation of the patient and the involved extremity. This evaluation should include the prosthetist who will be responsible for providing the appropriate prosthetic components and for close follow up supervision.

Following surgery and the application of the rigid dressing, a prosthetic pylon may be applied or be delayed indefinitely. (A pylon is an adjustable rigid supporting structure, usually tubular, whose proximal end is attached to a below knee socket, or to the knee unit of an above knee prosthesis, and whose distal end is connected to a foot-ankle assembly.) The immediate application has significant psychological beneft; the delayed application may be painful and awkward with the patient awake.

In the usual uncomplicated case, standing is encouraged the day following surgery and the prosthetist at this time completes the adjustments for alignment and length. Exercise, both in bed and standing, is encouraged and the degree of progressive ambulation with walker, parallel bars and crutches is controlled by the surgeon's judgement.

The young person with amputation for bone tumour or trauma will often bear progressive weight up to free ambulation without special discomfort and without apparent interference with rapid primary healing. Many older patients however are debilitated, being bedridden for months with chronic indolent ischemia — for these patients, weight bearing and ambulation are grossly restricted. The rehabilitation of the most severe of this group may begin with the use of a standing or tilt board. The prognosis for a very small group may be severe enough to prohibit any effort at ambulation until after change of the rigid dressing and wound inspection. However, the majority of patients whose stumps have healed *per primam* may be measured and fitted with a definitive socket and prosthesis 25 to 35 days post-operatively.

The advantages of rigid dressings and immediate prosthesis to the patient are:

(1) from the beginning, the patient knows that he will not be immobilized in bed or in a wheel chair and that he will be upright and ambulating with external assistance without delay;

(2) the unbroken physiological activity decreases the incidence of pulmonary and cardiovascular complications, particularly in the older patients;

(3) the rigid dressing prevents or minimizes swelling and edema and this unquestionably speeds up stump maturation;

(4) pain is decidedly less in the amputee group with the rigid dressings and early ambulation than in others with routine care;

(5) atrophy of muscle groups is minimized;

(6) total rehabilitation costs are reduced because of shorter hospitalization, earlier ambulation with a definitive prosthesis and a faster return to work in a normal environment.

Prosthetic Clinics

In order to manage all these complex medical and social problems, it is now widely accepted that specialized prosthetic clinics should be established. These clinics have personnel from several disciplines and can advise the patient and referring physician about the medical, prosthetic, vocational and social problems which may occur after an amputation.

The objectives of the prosthetic clinics are to provide physicians with consultation and prosthetic prescription and to recommend prosthetic training for their patients. Each patient's psycho-social-vocational needs, as well as his general health and condition of his extremity, determine the type of prosthetics recommended.

AMPUTATIONS IN CHILDREN

Amputations in children are special problems because of the factors of general body growth and of stump growth.

(1) *Congenital amputations* are due to a failure of development of the limb bud. The primary concern here is not one of further detruncation but of early application of a useful prosthesis. The first time a child may be aware of a missing upper limb is at the age of three months when he attempts two-handed grasp. These gross grasping activities are heavily practised and perfected in the normal child when he attains sitting balance at six to nine months. A limb-deficient child fitted with a mechanical replacement permitting gross two-handed grasp will practice and progress with a naturalness resembling the normal child. Without this mechanical replacement he ingeniously develops substitution patterns.

At the age of one year, the drive to walk appears. The child has been practicing the endless exercises of pulling up and standing for several months before the first step is attained. If his missing limb is replaced with a mechanical device supplying extra length, stability and comfort, he will start to walk as naturally as the device will allow. At no other age will he be able to master the walking practice so easily.

Surgery is therefore directed toward any element which interferes with the proper fitting and use of the artificial limb. The most common factor is the presence of small vestigial protrusions on the stump. These may or may not contain bony elements. They should be removed when their size and location interfere with the fit of the prosthesis.

(2) *Surgical amputations* in children are performed in the same general pattern as those in adults. The following points must be stressed in anticipating the factor of growth and its attendant abnormalities:

a) Level of amputation. The epiphyseal plate is preserved wherever possible in order to ensure the future growth of the stump. Disarticulation often provides a useful stump. Reamputation at a higher level may be done later should function not be satisfactory. When the bone must be sectioned above the epiphyseal plate, the most distal level within the area of election compatible with a satisfactory stump is chosen.

b) Skin. Although more tension may be safely used in the closure of amputation stumps in children than in adults, excessive skin tension is avoided. Skin grafts, although well tolerated, are seldom recommended; their principal use is in salvaging stump length. The presence of an excessive scar is seldom an indication

for refashioning an amputation stump although it usually requires special prosthetic fitting.

c) Bone. Periosteal stripping is kept to a minimum to avoid future new bone formation.

d) Nerves. These are treated as they are in adults. Painful neuromas are seldom encountered; if present, they should be located and removed.

e) Phantom limb. Although phantom limb does occur in the child amputee, painful phantom limb is virtually non-existent.

Juvenile Prosthetic Program

A prosthetic program for the limb-deficient child involves a number of people, both at the clinic and in the community: commercial prosthetists near the patient's home, occupational and physical therapists, the family physician, public or special school teachers, and school nurses.

It is essential for the clinic team to assess as early as possible the attitudes which the parents might have and whether there is any real interest in a prosthetic program.

It is also necessary to determine whether the child really needs a prosthesis. Not all limb-deficient children can benefit from a prosthetic device. A child may have a partial limb that is merely shortened or with the absence of one or more digits, and with the remaining portion more functional than any replacement.

Child Prosthesis Design and Fitting

The limb-deficient child with a prosthesis functions in a manner quite different from the adult amputee. The child's ability to operate a prosthetic device and the kind of use he will make of it, depends primarily upon his level of neuromuscular development. Thus it is essential for the individual child's capabilities and limitations to be carefully evaluated and defined before the prosthetist can design a functional prosthesis.

At the present time, most child prostheses are merely scaled down versions of adult devices that were engineered to utilize adult sources and ranges of power. In some cases it requires considerable ingenuity to adapt these existing designs so they can be made operative for children. This is particularly true in cases of congenital deficiencies of the phocomelia type in which the limb deficiency is often accompanied by bizarre muscular and skeletal structures.

In establishing design criteria, there are two major problems:

(1) the continual and sometimes rapid neuromuscular and skeletal changes due to growth;
(2) the child's limited sources of power and control.

It is preferable to design and fabricate the child prosthesis so some adjustments can be made later to compensate for changes in length, size and shape of the stump. This is accomplished by fabricating the socket so it can be ground out and reshaped as growth changes make adjustments necessary

Early Fitting of Prostheses

Early fitting has an important advantage in that physical activity will increase growth and strength. Any part of the body held immobile or only partially mobile, will not grow as fast as it would otherwise. A prosthesis will encourage the child in this physical activity. The power source for terminal device operation is not the same for all amputee types: a below elbow amputee uses elbow flexion to open his hook, the above elbow amputee uses shoulder flexion and usually some scapular abduction, while the shoulder disarticulation amputee is required to use biscapular abduction.

It is essential for the therapist to have an understanding of the control motions that activate each of the lower extremity prosthesis types, as these motions are basic to the training program. In general, standard prosthetic devices have standard control motions, and at the present time the same control motions are prescribed for children as for adults. In the case of specially designed devices (phocomelia prosthetics, for example) the control motions may differ.

Re-evaluation of Prostheses

The limb-deficient infant, like the intact infant, grows rapidly. Although growth slows somewhat in the second year, it is still rapid enough to require frequent changes of prosthesis. However, the circumference of fleshy parts changes surprisingly little and upper extremity sockets have been successfully worn from the age of six months to four years if compensations for length have been made. Moreover, where accurate form-fitting is needed about bony parts (as in bony prominences around the elbow, or in the partial foot) changes may occasionally be needed as often as every two to four months. During the preschool years, growth gradually slows, but the limbs (particularly the legs) lengthen more rapidly than the rest of the body and this necessitates frequent checking for prosthesis fit and alignment, particularly later in the adolescent spurts of growth.

Psychological Aspects of Amputation

Perhaps not enough attention is paid to the psychologic strain on the child (as well as on the adult) when an amputation is performed. Feelings of deprivation and resentment arising from a "dismembered complex" can frustrate the best design and executed prosthetics program. It can often be quite helpful if members of the clinic team can give counsel to even very young children. Even a child as young as three years has a right to an explanation and understanding of what is going to happen, especially if the surgery is to facilitate a prosthesis fitting. Considerations should also be given to the length

Now a sequential approach to treatment of the menopause

Estrogen replacement alone in the early part of the cycle plus conception control

From a recently published discussion of estrogen replacement therapy:

"*A much more practical means of therapy might be one of the combined or sequential oral contraceptive regimens. The supplemental estrogen therapy would be given and the dangers of unwanted conception eliminated.*"†

†Robert Burstein, MD, St. Louis, JAMA, Oct. 30, 1967. Vol 202, No 5.

ORTHO-NOVUM SQ alleviates menopausal symptoms by replenishing the estrogen deficiency. It is patterned on a natural cycle of estrogen for the early part of the cycle and estrogen plus progestin for the latter phase. Patients report regular menses with relatively unchanged flow, and minimal weight fluctuation.

ORTHO-NOVUM SQ provides the conception control essential to women entering the menopause.

ORTHO-NOVUM SQ—a sequential oral contraceptive now indicated for the menopause.

Ortho-Novum SQ*

Mestranol AND Mestranol WITH Norethindrone TABLETS

Ortho

ORTHO PHARMACEUTICAL (CANADA) LTD.
Don Mills, Ontario

*Trademark

Ortho-Novum SQ*

Mestranol Mestranol Norethindrone

COMPOSITION: The hormones used are familiar and well-proven. ORTHO-NOVUM SQ contains mestranol (ethinyl estradiol-3-methyl ether) and norethindrone (17 alpha-ethinyl-17-hydroxy-4-estren-3-one), the estrogen and progestin used in ORTHO-NOVUM* tablets for over ten years.

Each white tablet contains 0.08 mg mestranol. Each blue tablet contains 0.08 mg mestranol with 2 mg norethindrone.

INDICATIONS: The menopausal syndrome and sequential conception control.

DOSAGE AND ADMINISTRATION: For the first cycle only, have her take one white tablet a day starting on Day 5 of menstrual cycle followed by one blue tablet a day. At the end of the course of ORTHO NOVUM SQ, she stops the tablets for one week.

From now on, she simply completes each course of tablets, stopping at the end of each course for one week. The tablets should be started whether or not menstruation has occurred or is finished.

If spotting or bleeding should occur while taking ORTHO-NOVUM SQ, the tablets should be continued in the regular manner. It is not necessary to double the dosage.

CLINICAL EXPERIENCE: ORTHO-NOVUM SQ has proven highly effective in the control of conception and menopausal symptoms.

Almost all patients using ORTHO-NOVUM SQ tend to have a regular menstrual cycle with practically no change in amount of flow. Weight change is insignificant.

DURATION OF USE: As long as physician feels is desirable.

PRECAUTIONS AND CONTRAINDICATIONS: Although no causal relationship has been proven between the use of progestin-estrogen compounds and the development of thrombophlebitis, physicians should be cautious in prescribing ORTHO-NOVUM SQ Tablets for patients with thromboembolic disease or a history of thrombophlebitis.

Patients with pre-existing fibroids, epilepsy, migraine, asthma or a history of psychic depression, should be carefully observed. Pretreatment examination should include a Papanicolaou smear.

ORTHO-NOVUM SQ should not be taken: In the presence of malignant tumors of the breast or genital tract: In the presence of significant liver dysfunction or disease: In the presence of cardiac or renal disorders which might be adversely affected by some degree of fluid retention: During the period a mother is breast-feeding an infant.

PACKAGING: ORTHO-NOVUM SQ tablets are available in DIALPAK* Dispensers (one cycle of use).

Detailed information available on request.

*Trademark

Ortho

MEMBER PMAC

ORTHO PHARMACEUTICAL (CANADA) LTD.
Don Mills, Ont.

of time the child spends in hospital. In addition to being quite expensive, a long hospital stay, however well managed, is an abnormal substitute for home life and the child returns a stranger to the family which has not grown into this experience with him.

And so, the replacement of an extremity by a well functioning artificial one is not the sole answer to a child's problem. Both his ability to use the prosthesis and his adjustments to society will be conditioned primarily by his family's attitudes. If he has a sense of security, if he feels that he is wholly accepted, then he will have been given a very positive start toward meeting the problems that await him as he attempts to adjust to society and gain its approval.

ACKNOWLEDGEMENTS

I would like to thank Dr. D. Hastings of the Wellesley Hospital, and Dr. J. Hall of the Hospital for Sick Children for their assistance in preparing this article.

REFERENCES

1. Blakeslee, B. ed.: *Limb Deficient Child*, U. of California Press, 1963.
2. Crenshaw, A. H. ed.: *Campbell's Operative Orthopaedics*, C. V. Mosby Co., St. Louis, 1963.
3. Early Fitting of Prostheses Following Amputation, Surgical Clinics of North America, vol. 48, No. 1, p.215, Feb. 1968.
4. Mercer, Sir W.; Duthie, R. B.: *Orthopaedic Surgery*, Arnold publishers, London, 1964.
5. 'Rehabilitation of Amputees', Ohio State Medical Journal, vol. 63, p.1165, Sept. 1967.
6. Turek, S. L.: *Orthopaedics, Principles & their Applications*, J. P. Lippincott Co., Philadelphia, 1967.

INDEX TO ADVERTISERS

CHARLES E. FROSST & CO. ..... Outside Back Cover

HOMEWOOD SANITARIUM 147

ORTHO PHARMACEUTICAL (CANADA) LTD. 160-161

SMITH & NEPHEW LTD. ..... Inside Back Cover

SUN LIFE OF CANADA 152

TAYLOR INSTRUMENT COMPANIES OF CANADA LTD. 174

THE ONTARIO CANCER INSTITUTE 168

Chiropractic

Robert Snihura, 6T9

INTRODUCTION

Since 1895, there has been discord, generally silent, occasionally exuberantly outspoken, recently more aggressive, between the medical profession and chiropractic. The issue concerns those principles which underlie pathogenesis and treatment of disease, principles which differ conspicuously between the two groups.

It was in September of 1895 that Daniel David Palmer "discovered" chiropractic. Palmer was a Davenport, Iowa grocer and fishmonger who, before this revelation to medical science, worked with animal magnetism, a popular 19th century healing cult. In the capacity of magnetic healer, he was approached by a gentleman named Harvey Lillard who had been stricken suddenly by deafness seventeen years previously while in a stooped position. Lillard was examined by Palmer and found to have a demonstrable lump in the region of what Palmer later described as the fourth dorsal vertebra.[1] Palmer replaced the straying vertebra and within minutes Lillard's hearing was restored permanently to normal, after almost two decades of loss. Chiropractic was conceived! Chiropractic was conceived when manipulation of the upper dorsal spine restored function of the eighth cranial nerves.

DEFINITION OF CHIROPRACTIC

Chiropractic associations and institutes throughout the world provide varying definitions of chiropractic but in essence the practice may be defined by the explanation presented by the International Chiropractic Association in 1964:

"The philosophy of chiropractic is based upon the premise that disease or abnormal function is caused by interference with nerve transmission of spinal nerves, as a result of bony segments of the vertebral column deviating from their normal juxtaposition. The practice of chiropractic consists of analysis of any interference with normal nerve transmission and expression and the correction thereof by an adjustment with the hands of the deviations of the bony articulations of the vertebral column for the restoration and maintenance of health without the use of drugs or surgery. The term 'analysis' is construed to include the use of X-ray and other analytical instruments generally used in the practice of chiropractic."[2]

Although the preceding paragraph suggests that pharmacological and surgical measures are excluded from the therapeutic armamentarium of manipulators, there is variance of thought on this matter among chiropractors themselves.

In a few of the United States, there is a group of chiropractors which has extended its practice to include minor forms of surgery, obstetrics, and use of drug therapy.[3] This faction is referred to as the "Mixers" and is associated with the National Chiropractic Association. Eight of the current American schools of chiropractic follow principles of the mixers. It appears that mixers have encountered certain diseases which are somewhat more amenable to surgical, obstetrical, and pharmacological management than to manipulative technique.

In contrast to the mixers is the group of "Straights" affiliated with the International Chiropractic Association which champions the ideals in the definition given previously. The remaining seven American colleges and the sole Canadian school teach this latter philosophy.[2]

E. R. Burge, D.C., compares chiropractic to orthodox medicine: "Here lies the basic difference between the practice of allopathic medicine (referring presumably to the medical profession) and chiropractic. The allopathic practitioner will concern himself with prescribing a drug to counteract the associated micro-organism, stimulate the function retarded, or inhibit the function exhibiting excess. The chiropractor would attempt to adjust the structure to remove interference with normal nerve transmission with the expectation that the body alone has the innate knowledge of how to heal and restore normal function."[4]

All official definitions of chiropractic philosophy describe the disruption of nerve force causing disease, according to Palmer's original principles.

PRINCIPLES OF CHIROPRACTIC

Palmer was a self-educated man and in the course of his learning set down certain postulates which have been upheld rigidly by teachers of chiropractic to the present. Palmer explained that "Life is the expression of tone. In that sentence is the basic principle of chiropractic." His fundamental premise was that each cell in the human body commands an "Innate Intelligence" which enables the cell to function biologically and to effect reparative measures when subjected to trauma, be it chemical, mechanical or mental. The body has an inherent ability to heal itself but it requires the assistance of a harmonious nervous system for proper performance — harmonious in the sense that a balance of "nerve force" exists in the body. When equilibrium is disturbed by abnormal nerve force, by abnormal tone, then "Innate Intelligence" cannot properly execute its function in restoring the healthy state. The result of this dysfunction is "dis-ease."[1]

Disequilibrium may be produced by either an increase or decrease in nerve force. Palmer states that "too much or not enough energy is disease" and he presumed that disease was the result of the vertebral subluxation affecting the spinal cord which will be further discussed below.

The Canadian Chiropractic Association currently lists the following five principles upon which the theory of modern chiropractic is based:

" (1) that a vertebra may become subluxated;

(2) that this subluxation tends to impingement of the structures (nerves, blood vessels and lymphatics) passing through the intervertebral foramina;

(3) that as a result of such impingement, the function of the corresponding segment of the spinal cord and its connecting spinal and autonomic nerves is interfered with and the conduction of the nerve impulses impaired;

(4) that, as a result thereof, the innervation to certain parts of the organism is abnormally altered and such parts become functionally or organically diseased or predisposed to disease;

(5) that adjustment of a subluxated vertebra removes impingement of the structures."[5]

CHIROPRACTIC EDUCATION

The Palmer School of Chiropractic pioneered chiropractic education and continued under the administration of Palmer's son, B. J. Palmer. Since the beginning of this century, fifteen schools have been established in the United States and one school was opened in Toronto in 1945. The latter, The Canadian Memorial Chiropractic College, is the sole school of chiropractic in Canada. Chiropractors currently practise in most of the United States and Canadian provinces and in various countries about the world.

Presently, in the Canadian school, a grade 13 or equivalent standing is required from students wishing to enrol in the four-year course which involves approximately 5,000 hours of training. Courses of study include anatomy, bacteriology, chemistry, diagnosis, first aid, jurisprudence, obstetrics and gynecology, pathological chemistry, pathology, pediatrics, physical medicine, physiology, psychology, public health and x-ray. Students graduate with a Diploma in Chiropractic or D.C. (not recognized as doctor).

Chiropractors, although licensed in most provinces, are not allowed hospital privileges and have no access to Provincial laboratories. Canadian and provincial health schemes do not recognize chiropractic treatment but chiropractic is covered by the Ontario Workmen's Compensation Board. In this country and in most American states chiropractors are forbidden by law to practise surgerry or obstetrics or to administer drugs or anaesthetics[6]. Nevertheless, some American chiropractic associations have extended to their members the privileges of minor surgery, obstetrics, and drug therapy.

The admission standards of chiropractic schools were recently found by the American Medical Association to be grossly deficient.[7] A letter of application was mailed to each of seven American chiropractic schools deemed most respectable by chiropractors. Each letter was from a fictitious character and was purposely written, in form and content, to suggest the extremely substandard qualifications of the applicant. Five of the applications were at least provisionally accepted after exchange of correspondence. It appears from this study that chiropractic does not in fact maintain the careful admission screening that it purports. Whether or not the level of proficiency in the undergraduate years is equally inadequate is a matter of conjecture.

THE SUBLUXATION

The subject of the vertebral subluxation has been briefly mentioned and now will be considered in greater detail.

The chiropractic subluxation is defined by the chiropractic proponent Homewood[1] as a "fixation" of a vertebra "within its normal range of motion with its facets continuing to articulate with those of the vertebrae above and below." This disrelation of vertebrae results from muscular hypertension but "does not alter the size of the associated intervertebral foramina materially."

A strain of the supporting soft tissues of the vertebral column may result from damage inflicted by direct or indirect trauma, for example, the improper lifting of an excessively heavy object. Nerve endings in the torn soft tissue subsequently bombard the dorsal roots of the associated spinal nerves with afferent impulses. These nerve impulses enter the spinal cord, partly to stimulate pain fibres which ascend to the sensory cortex, partly to stimulate adjacent anterior horn cells via collateral fibres. Irritation of the motor fibres produces contraction of the paravertebral muscles which action results in fixation, or chiropractic subluxation, of the vertebrae in the vicinity of the injury. Although this subluxation is said by Homewood not to appreciably narrow the intervertebral foramina, the second principle of the Canadian Chiropractic Association explains that pressure is in fact exerted on contents of the foramina. By compression and therefore irritation of the afferent nerve fibres, the last link is produced in a continuous cycle comprising fixation of vertebrae, nerve irritation, increased number of afferent impulses, increased stimulation of the anterior horn cells, stronger fixation, and so on. The imbalance of nerve force of which Palmer speaks is thus established.

The chiropractic subluxation is said to be frequently mild and subclinical, devoid of signs and symptoms. However, the fixation may become clinically manifest when the patient is further subjected to any form of irritation causing excess "nerve force" in the posterior nerve roots near the subluxation. Such irritation may originate from mechanical, chemical, or mental causes.[1]

Mechanical stress occurs with back strains associated with lifting, falling, and faulty posture, all of which, as Homewood describes, may increase impulses into the

sensory nerve roots to aggravate the subluxation "cycle". In a similar fashion chemical causes, for example, gastric irritation, constipation with "absorption of toxins" and respiratory inhalants, may produce signs and symptoms of a subluxation. Mental irritation of a fixation apparently operates by stimulating the anterior horn cells via vaguely defined fibres within the central nervous system.

Although the existence of a subluxation does not, in the opinion of Homewood, necessarily compress the nerve root, it is considered to compromise the blood supply to the nerve roots and trunks causing ischemia of the neurones. Neural ischemia results in either enhancement or depression of conductivity within the anterior roots. Activity of structures, both somatic and visceral, which derive nerve supply from these motor roots is therefore increased or decreased respectively.

Following this reasoning, Homewood explains how an upper thoracic fixation, by irritating sympathetic fibres supplying the wall of the aorta, creates arterial hypertension. Pathogenesis of a gastric ulcer is similarly explained: subluxation of a thoracic vertebra leads to "local vascular constriction of the vessels of the gastric mucosa. The resistance is thereby reduced to the gastric secretions, which are then capable of digesting the mucosa with formation of an ulcer and the resulting symptoms." It is also proposed that fixation of a vertebra from the fifth to the ninth segments may "over-activate the release of glucose from the liver with a hyperglycemia developing and even a demonstrable glycosuria."[1]

In a similar fashion the chiropractic cause of most disorders appears to be found in the irritation or suppression of nervous activity which follows a vertebral subluxation.

The continually reinforced cycle previously described may be interrupted by adjusting the subluxated vertebra, thereby restoring normal anatomical relations. Manipulation is repeated at variable intervals of time enabling normal neural activity to return. In this manner, the hypertension is reduced, the gastric ulcer resolves and the blood glucose level returns to normal, according to chiropractic.

For many patients with low back pain and associated muscular spasm but without demonstrable pathology, spinal manipulation may well be of benefit. Indeed, manipulation has been used by physicians in some cases and has been found to be useful in relieving symptoms temporarily.[8 9] However, it has not been shown that systemic disorders are in fact affected by chiropractic adjustments of the spine.

Diverse claims of therapeutic success are made by chiropractors. Homewood outlines through various examples how severe illnesses may be treated by spinal manipulation. He illustrates how acute coronary arterial occlusion for example, would be managed by a chiropractor: ". . . when the doctor of chiropractic arrives at the bedside of a patient, who has experienced some form of cardiac attack and displays a very low blood pressure and a feeble contraction of the cardiac muscle, the doctor does not wait to reason through the many and varied signs that point to the offending vertebra or vertebrae, but immediately delivers a stimulative form of upper thoracic adjusting. Such a stimulation is helpful in increasing the strength of cardiac contraction. The doctor may deliver stimulatory adjustive moves in the area of the ninth thoracic to stimulate the adrenal glands to further assist in the emergency response." The author continues that "Experience has established the fact that the administration of chiropractic adjusting is efficacious in handling both the acute and chronic cases of coronary occlusion."[1]

Similar claims of success are made in treatment by manipulative technique of numerous other diseases among which chiropractors include: asthma, colitis, the common cold, diabetes mellitus, dysmenorrhea, hay fever, Menière's syndrome, mental illness, and tic douloureux. Some chiropractors even boldly state that they have adjusted cancer patients into health!

Chiropractic may be of benefit in certain circumstances but more importantly it may prove to be detrimental to the patient. Danger lies in the combination of inadequate diagnostic techniques and the almost inevitable delay in treatment of potentially remediable disease.

In determining the presence of a subluxation of the vertebral column, chiropractors emphasize the signs and symptoms attributed directly or indirectly to altered nervous function and the use of various devices, including X-rays, as instrumental aids.

Increased muscle tension with local tenderness is demonstrable clinically by palpation of paravertebral tissues and should suggest previous, often recent, injury to the back. Organs deriving nerve supply from the involved segment may be disturbed sufficiently to produce evidence of abnormal function, for example, hiccoughs, constipation, epigastric pain and tenderness, and so forth.

Chiropractors, furthermore, are able to discern alterations in skin, subcutaneous tissue and muscle character. The chronic subluxation induces skin changes varying from "a thin, glossy texture to a thickened, roughened, discoloured patch, resembling a callus formation"; the subcutaneous tissues are perceived as "ranging all the way from a 'shiny' feeling of 'skin-slip' to a granular disposition"; changes in muscle texture encompass those from "apparent fibrotic change to the cord-like, stringy band of the chronic contracture."[1] Differences in temperature and electrical conductivity are clinically measurable by use of appropriate instruments.

Other analytical instruments generally used by the modern chiropractor include devices such as the "Panoramic Plumb-line Posturometer" devised by L. C. John-

ston, Research Director of the Canadian Memorial Chiropractic College. This machine enables the chiropractor to study body contour and posture and aids in locating subluxated vertebrae. The "Visual Nerve Tracer" elicits for the unaided chiropractic eye details concerning cutaneous discolouration secondary to the vascular changes caused by disturbance in vasomotor tone. Several other ingenious diagnostic devices are presently in the possession of the American Food and Drug Administration.[10]

The practice of chiropractic includes the use of radiology. Chiropractors generally rely on full length (36" by 14") spinal films for examination of the spine. Such technique, however, almost invariably precludes accurate investigation because of both inadequate exposure and excessive distortion from secondary radiation. Virtually no information is provided except about gross misalignments of the spinal column. Soft tissue pathology cannot be detected by these films; tumours of the vertebrae may be easily overlooked; and degenerative changes, even advanced, may go unnoticed. In these instances, several months of useless and potentially harmful manipulation could transform a curable illness into a terminal one either by delaying proper care or by inducing extensive trauma.[11]

With these inadequate methods, the subluxation is said to be detected. However, it is difficult to place credence in Homewood's statement that "no matter the technique of radiology employed, the true subluxations are revealed to the skilled chiropractor, for the abnormal facing of the subluxated vertebra remains a constant finding at rest, or at any point in the motion."

VIEWS ON MICROORGANISMS

It is thought by many that chiropractic philosophy is divorced from principles of bacteriology. This is not entirely so. Chiropractic recognizes the presence of microorganisms and in fact the student of chiropractic is exposed to 180 hours of bacteriological studies in the course of his undergraduate training. However, there is a concurrent feeling among manipulators that minimizes the value of the infecting agent, but sresses the host state. Imbalance of "nerve force" resulting from a subluxation lowers host resistance rendering the host susceptible to infection. Manipulation of the subluxated vertebra restores normal nerve balance and, according to chiropractic opinion, the invading microorganism should disappear.

Homewood discounts the value of passive immunization against communicable disease, suggesting that decline in such disease is coincident with improvement in sanitation, not with the advent of anti-bacterial agents. The importance of public hygiene cannot be overemphasized but, on the other hand, it is unreasonable to stress that "artificial immunity, the false sense of protection" has "risks of neuro-dystrophic processes being initiated, which may be productive of tissue changes more detrimental than the disease itself."[1]

Chiropractors contend that vaccination in pediatric clinics is an outrageous practice, that innoculations produce deleterious long-term effects in the form of the "nervous dystrophic process" which renders the nervous system more susceptible to minor insults such as "germs".

Homewood summarizes this opposition to inoculations by quoting Speransky, " 'Consequently, the clinic, and especially the children's clinic, should accurately estimate the real need for skin tests and all sorts of inoculations, and become quite clear as to the reality of their harmlessness; otherwise, the so-called achievements of science (?) may easily be converted into one of the methods of crippling humanity.' " Will humanity not be crippled by an epidemic, when immunization is forestalled in order to accurately ascertain the real need for effecting universally successful preventative measures? Ideas of the above calibre evident in modern chiropractic literature lead one to doubt whether the cause of chiropractic, let alone the cause of science, has been advanced since its inception.

SUMMARY

Chiropractic was defined and its principle described. A brief sketch of chiropractic education and practice was given. Detailed consideration was given to the vertebral fixation or chiropractic subluxation which is, in chiropractic opinion, the underlying cause of most disease. Chiropractic thoughts about microbiology were also described.

CONCLUSION

The philosophy of chiropractic is largely based on outdated and unsound theories of causation of disease and is applied much too broadly to the therapy of medical disorders. Established and oft proven medical principles are contradicted by irrational chiropractic notions. In the final analysis, where treatment by manipulative technique is indicated by a physician, physiotherapy soon will successfully usurp the field of chiropractic.

REFERENCES

1. Homewood, A. E.: The Neurodynamics of the Vertebral Subluxation. 1962.
2. Report on Chiropractic. The Nature of Chiropractic. Med. J. Aust. 2: 1059-1060, Nov. 26, 1966.
3. Chiropractic Trends. New England J. Med. 267: 939-940, Nov. 1, 1962.
4. Burge, E. R.: Chiropractic. C.A.M.S.I. J. Med. 26: 4-11, April, 1967.
5. Sutherland, D. C.: Chiropractic Viewpoint. J. Can. Chiropractic Assoc. Vol. VIII, No. 2.
6. Mills, D. L.: Study of Chiropractors, Osteopaths, and Neuropaths in Canada. Royal Commission on Health Services. Queen's Printer, Ottawa. 1966.
7. Requirements for Admission to Schools of Chiropractic. J.A.M.A. 190: 763-764, Nov. 23, 1964.
8. Collings, J. S.: Techniques of Manipulation. Med. J. Aust. 47(2): 55-60, July 9, 1960.
9. Swaney, W. E.: Manipulative Technique. Med. J. Aust. 47(2): 60-61, July 9, 1960.
10. Chiropractors Surrender Six Fraudulent Devices. Amer. J. Med. Electronics. 4: 22, Oct.-Dec., 1965.
11. Neurologic Complications of Head and Neck Manipulations. J.A.M.A. 182: 528-531, Nov. 3, 1962.

Low Back Pain - Etiology And Pathogenesis

Z. Cohen 6T9
T. F. Shapero 6T9

Pain in the lower lumbar area can theoretically originate in several different structural elements. Local pain may be caused by any pathologic process irritating the structures containing sensory nerve endings: border areas of the annulus fibrosus, the posterior longitudinal ligaments, the periosteum, the synovial membranes of the intervertebral joints, and the paravertebral muscles. Involvement of structures containing no sensory endings is painless; thus, the substances of the vertebral body may be destroyed by tumor without evoking pain until the periosteum is involved. The nucleus pulposus of each intervertebral disc is also devoid of sensory nerves.

DISC DEGENERATION

The exact pathogenesis of low back pain is essentially unknown; however, discussion is focused mainly on the structural, functional and biochemical aspects of the intervertebral discs. The disc, the adjacent vertebrae and the anterior and posterior longitudinal ligaments show early signs of progressive degeneration due to aging. Structurally the disc consists of collagen and mucopolysaccharides; the central part, or nucleus pulposus, contains a gelatinous substance with a high water content, a porous collagen network and a layer of chondroitin sulphate. During the natural process of aging, the water content of this polysaccharide complex gradually diminishes and therefore the nucleus loses its gelatinous properties, resulting in a more fibrous and dense irregular core. Such changes are found in people between the ages of 20 and 30, but in the higher age group this is the usual picture.

The ring of denser, more regular collagen fibres surrounding the nucleus is the annulus fibrosus. These fibres are attached to the hyaline end plates which divide the bony structure of the adjacent vertabrae from the disc. The annulus is also the site of early structural changes. The collagen bundles undergo progressive deterioration and loss of continuity, beginning approximately at age 20. These ruptures become more frequent with increasing age and gradually the necrotic areas which develop in the annulus are replaced by an irregular and dense connective tissue.

It is as yet unanswered why such progressive and irreversible disc deterioration may proceed without producing clinical symptoms. However, these structural changes in the intervertebral disc are still considered the primary cause of lumbar disc herniation which is recognized as a major cause of severe and chronic or recurrent low back pain. This condition occurs most frequently between L5 and S1 vertebrae and, with decreasing frequency, between L4 and L5, L3 and L4, and L2 and L3. As mentioned above, the deterioration of the intervertebral disc results in a tough fibrous nucleus pulposus and a weakened annulus fibrosus. In addition, stressful flexion-rotation movements and minor spinal trauma which occur throughout life also weaken the annulus fibrosus and the posterior longitudinal ligaments, thereby producing segmental instability and localized back pain due to involvement of sensory nerve endings in the annulus or ligaments.

Furthermore, the weakened disc and ligaments now respond to flexion and rotation movements, however trivial, in an abnormal manner. The tough fibrous nucleus is driven backward on the anterior surface of the annulus by flexion of the spine. Rotation movements cause the fibrous nucleus to erode the inner surface of the annulus. Eventually the nucleus pulposus entirely erodes the annulus and extrudes the frayed weakened ligaments laterally and usually unilaterally producing the characteristic root pain of a ruptured intervertebral disc. The mechanism of root pain is simply spinal nerve root irritation secondary to compression and distortion induced by the extruded nuclear fragments; exacerbation of the pain may then occur through actions such as coughing, sneezing and straining. Stretching the nerve by straight-leg raising will excite root pain. Jugular vein compression, which will elevate intraspinal pressure, may also cause a shift of the nerve root and thus elicit pain.

Functionally the vertabrae are joined together to form a mobile system. While the nucleus pulposus remains a gel, the intervertebral disc acts as a 'shock-absorber'; that is, the disc resumes its original shape on removal of a mechanical strain and the vertebral bodies ride easily upon each other. With aging, the nucleus pulposus becomes fibrosed, and the efficiency of the shock-absorber is largely lost. Thus, the distribution of stress is changed. The rims of the vertebral bodies now accept the major portion of the stress transmitted through the annulus. The opposing rims of the vertebral bodies no longer glide easily over one another and thus pain is produced on movement. The vertebral bodies become thicker and stronger due to osteophyte formation. The unsupported annulus flattens and thins centrally. As the annulus disintegrates, the disc decreases in height with eventual collapse. Radiography reveals degenerative changes as a narrowed disc space and "vertebral body lipping", or osteophyte formation.

DISC CHEMISTRY

Recent research on low back pain has concentrated on the chemical nature of the disc. The disc contains polysaccharide-bound proteins; however, because of the avascular nature of the disc, these proteins lack communi-

cation with surrounding structures and thus remain enclosed within the intervertebral space. As degenerative structural changes within the disc progress, the polysaccharide-bound proteins may be released into surrounding structures where they may act as foreign bodies. By reaching the vascular channels of these surrounding structures the protein complexes could evoke a tissue response in the form of reactive inflammation, thus irritating the local sensory nerve endings and causing pain. Although this is still an unproven concept, the chemical aspects of disc reactions on surrounding structures probably will prove to be of major significance as knowledge of the pathogenesis of low back pain unfolds.

PSYCHOGENIC PAIN

The discussion of the pathogenesis of low back pain would be incomplete without considering its psychological aspect. The basic link between the psyche and low back pain is affect. That is, emotion, expressed as anger, fear, disgust, hopelessness, hatred, depression, envy, grief, injury, weakness, or impotence, influences the awareness of pain. The pain of a physical lesion in the back may be intensified out of proportion to the severity of the lesion, depending on the individual's emotional nature. For example, if the person is afraid or weak, or if he has had a traumatic experience in relation to the pain, then the pain may preoccupy him mentally, resulting in an intensification of the pain.

The second way in which emotion can evoke pain in the lower back is by producing psychogenic muscular pain. In life-threatening situations, in anxiety and emotion, there is general muscular tension. In these situations the erector spinae and buttock muscles are held in a tense spasm thus producing tenderness over the muscle.

The third and most important cause is the psychogenic regional pain syndrome. Here the back pain is described in an unanatomical region, not conforming to the usual lumbo-sacral pattern of segmental innervation (dermatome, myotome, sclerotome). The pain is hallucinatory or hysterical. The region will almost always show some tenderness with sensory and/or motor disturbances. In addition, close questioning often reveals the experience of personal injury with damaged feelings and a sense of grief or loss. According to Walters, this syndrome is "a regional, physical expression of psychological trauma encountered in states of depression, hysteria, schizophrenia and in many other situational states".[1]

The lower back is the third commonest site of psychogenic regional pain. This region is readily involved because it is important not only for supporting the body, but also for locomotion, for potency and for the ability to manoeuvre in threatening situations. When these functions are threatened, then the low back region may be the site where the patient feels the painful incompetence of not having enough power to breast the life situation that is threatening.[1] It is of utmost importance in psychogenic regional pain to classify, not the pain itself, but the individual from which the pain arises. This is necessary before the treatment can be instituted because different psychiatric conditions producing essentially the same type of pain must be managed in entirely different manners.

TRAUMA

Compression fractures of the lumbar vertebrae produce an immediate or latent, localized back pain. These fractures are usually the result of flexion injuries. The classical signs leading to a diagnosis include limitation of forward flexion of the spine, short sharp pain on percussion of the affected area, spasm of the lower lumbar muscles and, of course, radiologic evidence of damage. Fractures of the transverse processes are more difficult to diagnose. The pain is usually associated with local muscle spasm on one side only. Percussion of the affected area produces a deep aching pain. The psoas muscle on the affected side is often damaged resulting in weakened hip flexion on that side.

The exact diagnosis of ligamentous sprain or injury is difficult, although definite instability may be demonstrated in some cases. The diagnosis is usually based on localized tenderness plus augmentation of pain when tension is applied to the involved site by means of movements of the spine.

Muscular injuries and sprains result in spasm which itself produces a diffuse pain. This pain results from both the localized spasm of erector spinae and gluteal muscles and the pull of these tense muscles on their periosteal attachments.

DEGENERATION

PROTRUSION or herniation of a lumbar intervertebral disc with or without sciatica, is a common cause of low back pain. The classical syndrome is characterized by dull, aching pain, with limitation of forward spinal flexion and sciatica. The onset is sudden, usually with a flexion injury such as a bending or lifting strain. Unilateral sciatica may develop later in the course of the acute episode. The herniated discs most often affect the 5th lumbar and 1st sacral roots, resulting in pain in the region of the hip, groin and gluteal areas, the posterolateral thigh, the posterior and lateral calf to the heel, dorsal and plantar surfaces of the foot, and the toes. Tenderness is usually most pronounced in the gluteal region, around the head of the fibula and along the calf. In the foot, paraesthesia or numbness is quite common in the typical syndrome. Abnormality of posture is the usual result. The straight leg raising test is most significant clinically if the back or limb pain is reproduced during the test. It is important to palpate the course of the sciatic nerve in the thigh to rule out the presence of a nerve tumor.

ARTHRITIS

Arthritis of the spine is a relatively common cause of back pain. It is difficult to evaluate the significance of

hypertrophic and degenerative arthritis because both are considered to be the result of aging. In young men complaining of low back pain, one must be aware of rheumatoid spondylitis. These men complain of morning stiffness and stiffness when resting after a period of activity. Sciatica may or may not be present. Elevated erythrocyte sedimentation rates and early radiologic signs of destruction of the sacro-iliac joints are important findings in this condition. On occasion, osteoarthritis renders the posterior intervertebral joints unstable by degeneration of the articular cartilage. This most often occurs between L4 and L5 and may result in spondylolisthesis.

INFECTION

Systemic disease such as tuberculosis and pyogenic osteomyelitis may also affect the spine producing a dull, aching, persistent nocturnal pain. Fever may or may not be present. The white blood count is usually elevated. The most valuable laboratory test is the sedimentation rate which is consistently elevated. Tuberculosis of the spine (Pott's disease) may not show up radiologically until late in the disease. Osteomyelitis, in addition to causing localized tenderness and producing positive blood cultures, may appear radiologically as bony rarefaction, local periosteal elevation or new bone formation with associated destruction of intervertebral discs.

ACKNOWLEDGEMENT

The authors would like to thank Dr. H. Larocca of the Wellesley Hospital for his time and effort in reading the manuscript and suggesting improvements.

REFERENCES

1. Walters, A.: Emotion & Low Back Pain. Applied Therapeutics: Oct., 1966.
2. Burke, G.: Etiology & Pathogenesis of Spinal Pain. Applied Therapeutics: Oct., 1966.
3. Harrison, T. R.: Principles of Internal Medicine. McGraw-Hill Book Co., New York, 1966.
4. Knapp, M. E.: Low Back Pain. Journal of Postgraduate Medicine, February 1967.
5. Bianco, A. J.: Low Back Pain and Sciatica. Journal of Bone & Joint Surgery. Vol. 50-A, January 1968.

CANADA – THE ONTARIO CANCER INSTITUTE
RESIDENT TRAINING IN THERAPEUTIC RADIOLOGY

The Ontario Cancer Institute incorporating The Princess Margaret Hospital offers a two - year Diploma Course which combines clinical work on the wards and in the Outpatient Department of the hospital, and didactic courses in Physics, Anatomy, Pathology, Radiobiology, and Radiotherapy. This course leads to the Diploma in Medical Radiotherapy from the University of Toronto and is accredited by the Faculty of Radiologists in London. The hospital is also accredited by the Royal College of Physicians and Surgeons of Canada and the American Board of Radiology for complete training in Radiotherapy over a period of three years. In addition it is also accredited for Internal Medicine and Anatomic Pathology for a period of one year and for six months in Diagnostic Radiology. An additional year of training may be undertaken and a limited number of one year appointments are also made.

The Princess Margaret Hospital provides complete facilities for cancer research, diagnosis and treatment, exclusive of major surgery. Over 3,500 new patients are seen annually; there are 185 active treatment beds, and facilities include 7 Cobalt Units, two Caesium Units and a Betatron. Salaries range from $7,100 to $9,500 per annum.

Applications are invited for the year beginning 1 July, 1969. For further details enquiries should be addressed to:

THE CHAIRMAN OF THE INTERNE COMMITTEE,
THE PRINCESS MARGARET HOSPITAL,
500 SHERBORNE STREET, TORONTO 5, ONTARIO, CANADA.

Low Back Pain - Classification And Management

Bob Sorokolit 6T9

While the patient may call it a backache, it can often be a headache for the physician. Low back pain is a common complaint (Hirsch estimated that about 65 per cent of the Swedish population at one time has been affected[1]), yet it can often be an enigma to diagnose, treat and rehabilitate effectively.

Over the years the various protean causes have led to changing fashions in the popular diagnoses: lumbago, sciatica, sacro-iliac strain, ilio-tibial tightness, lumbalgia, pinched nerve, herniated disc, intervertebral disc degeneration, posterior facet syndrome, apophysitis, slipped disc, fibrositis, low back syndrome, orthopedic back, compensation back, or just plain postural backache.

Treatments likewise have rambled the gamut from the traditional triad of bed rest, local heat and aspirin to the more elaborate regimens of whole body traction, chiropractic manipulation, massage, exercising, diathermy, braces, belts, corsets, liniments, opiates, muscle relaxant drugs, tranquilizers, laminectomy, discotomy and even spinal fusion.

An American study[2] indicated that low back pain amounted to about half of the total cost of all types of injuries and disabilities in industry each year. And in Canada, White[3] calculated that work lost due to backaches far outweighs any other time loss in the adult male group.

In view of the frequency of this condition and of the minimal, if any, experience that medical students get with backache patients, this article will mainly review the many causes of low back pain with the treatment and rehabilitation of the most common problems.

TYPES OF PAIN[5]

1. *LOCAL PAIN*. The localized pathologic lesion irritates any nerves present, giving a steady diffuse ache accentuated near the affected area and tenderness to firm finger pressure.

2. *SPASM PAIN*. As a secondary phenomenon, spasm occurs with most spinal conditions producing local pain, via a protective self-splinting reflex mechanism of the particular myotome. Initial spasm may not be painful, but constant tension of the erector spinae and glutei muscles pulls on their sensitive periosteal attachments, giving a dull diffuse ache throughout the tense muscle.

3. *REFERRED PAIN*. One type projects from the spine to regions within the lumbar and sacral sclerotomes in the leg and tends to be deep and aching, sometimes altered by posture. A second type projects from the pelvic and abdominal viscera to the spinal midline. It is not localized well nor affected by posture, although it is modified by visceral activity and is sometimes continuous nocturnally.

4. *ROOT PAIN*. Root irritation originates near the intervertebral foramen and, although similar to referred sclerotome pain in the legs, has a greater intensity and is usually superimposed on the dull ache of referred pain. It is elicited by stretching the nerve roots, especially the components of the sciatic, by hyperextending the knee and dorsiflexing the foot. Associated sensory, motor and reflex changes may develop.

COMMON LOCATIONS OF PAIN

1. costo-vertebral angle — genito-urinary or adrenal origin, or transverse process of first lumbar vertebra
2. transverse process — fracture or muscle sprain
3. spinous process — fracture or scoliosis
4. interspinous ligament — acute sprain, especially between fifth lumbar and first sacral spines due to hyperextension or hyperflexion, degenerated disc involving a root, or commonly strain of bad posture
5. dorsal sacrum — postural strain, often with congenital scoliosis
6. sacro-iliac ligaments — sprain in only some severe cases, often involving the symphysis pubis

ETIOLOGY

A. Congenital

1. spina bifida
2. spondylolysis
3. spondylolisthesis
4. hemi-vertebra
5. articular facet malposition
6. sacralization of lumbar vertebra
7. lumbarization of sacral vertebra

Developmental defects may produce pain but usually predispose to mechanical alterations which later produce or aggravate pain, tend to postural change and strain, and are more easily precipitated by injury. Bifida with its absent fusion of a lamina of the neural arch shows superficial signs of hypertrichosis and hyperpigmentation. Spondylolysis occurs in five per cent of people, usually asymptomatically; here cartilage replaces the bone defect of the pars interarticularis. Following this initial cartilaginous replacement may come spondylolisthesis, a forward displacement of the vertebral body, usually the fifth lumbar.

B. Postural Defects

1. exaggerated lumbar lordosis
2. hip flexion contracture
3. unequal leg length
4. pronated flat feet
5. tight Achilles tendon

These are the most common causes of mild chronic diffuse ache induced by prolonged standing, relieved by bed rest and compounded by poor rectus abdominis tone, obesity, pregnancy, sleeping prone on a soft mattress, slouching and wearing high-heeled shoes.

Postural strain and weakness can lead to secondary pain precipitated by a relatively minor strain. The incidence of postural strain is small in the young and old but is higher in the 30 to 55 year group.[6]

C. Traumatic

1. recent fracture
2. old fracture
3. ligamentous strain
4. ligamentous sprain
5. muscle and fascial tear
6. fat herniation into muscle
7. hemorrhage and hematoma in muscle and ligament
8. tearing of posterior zygo-apophyseal joint ligaments

Trauma is the most common cause of acute pain, often following sudden extension, such as lifting a heavy object and rotating with poor leverage. A strain is a minor injury without gross structural damage, relieved by rest. A sprain is more serious and involves definite structural damage, heals slowly and may also involve muscles and tendons. Recent fractures may include the spinous or transverse processes with a psoas tear. Old fractures may not have been adequately reduced and may develop a deformed facet or pedicle or a compressed body.

D. Degenerative

1. disc degeneration
2. lumbar disc protrusion
3. apophyseal hypertrophic osteoarthritis

Clinical findings plus spinal x-rays and pantopaque myelography or laminography help locate these common causes of severe chronic and sometimes incapacitating back and leg pain. Degeneration begins as early as age 20 with progressive dehydration of the gelatinous nucleus pulposus. Narrowing of the space may allow subluxation of the apophyseal joint, permitting hyperextension and leading to chronic osteoarthritis and vulnerability to constant extension strains, but rarely causes nerve root pressure.[7] The annulus fibrosus deterioration[8] also begins about age 20 and with extension strain may produce unilateral herniation postero-laterally, mainly between the fifth lumbar and first sacral and occasionally between the fourth and fifth lumbar vertebrae. Herniation occurs usually between the ages of 30 and 50 but not over 60 when the collapsed discs have lost the ability to bend. In most people over 50, osteoarthritis can be demonstrated by x-rays, but is usually well tolerated except with associated injury, obesity and bad posture.[9]

E. Infectious

1. osteomyelitis
2. epidural abscess
3. meningitis
4. fibrositis and myofasciitis
5. herpes zoster

Herpes zoster can be painful several weeks before the typical dermatome rash appears and sometimes remains permanently in older people after the rash disappears. The usual but uncommon bone and joint infections are tuberculosis, staphylococcosis, brucellosis, actinomycosis and blastomycosis.

F. Neoplastic

1. benign hemangioma
2. benign cord tumors
3. osteoid osteoma in children
4. malignant primaries and secondaries

X-ray signs are present in only 25 per cent of symptomatic secondary tumors from the prostrate, breast, bronchus, uterus, stomach, thyroid and kidney. Primary malignancies are uncommon and include osteoproliferative Hodgkin's or osteolytic lymphomas, retroperitoneal sarcoma, neurofibroma and myeloma.

G. Vascular

1. atherosclerosis
2. thrombosis
3. aneurysm
4. hemorrhage

The vertebral and popliteal arteries and the abdominal aorta are damaged most frequently, the superior gluteal arteries rarely. Retroperitoneal bleeding can complicate anticoagulant therapy.

H. Metabolic

1. osteoporosis
2. osteitis deformans (Paget's)
3. gout
4. adiposis dolorosa
5. alcaptonuria (ochronosis)

The first two disorders may be painless, although osteoporosis can lead to collapse and wedging following even a minor back injury. Adiposis is a painful subcutaneous lipoma.

I. Visceral Referred

1. menstrual cramps
2. endometriosis
3. uterine prolapse
4. uterine cancer
5. late pregnancy
6. chronic cicatrical urethritis

7. prostatic carcinoma
8. pyelonephritis
8. colitis
9. diverticulitis
10. rectal carcinoma

With referred pain there are either no local signs or else vague ones, with a full range of painful spinal movements. Pelvic pain is accentuated premenstrually in the sacral region with endometriosis and cramps or else utero-sacral ligament stretching in pregnancy or prolapse. Obviously rectal and pelvic examinations are important for back pain diagnosis.

J. Neurological

1. peripheral neuritis
2. diabetic polyneuritis
3. multiple sclerosis

K. Inflammatory

1. early rheumatoid arthritis
2. ankylosing spondylitis
3. other arthritides

L. Psychological

1. anxiety reaction
2. psychogenic regional pain syndrome
3. neurotic depression
4. hypochondriasis
5. unstable personality

Emotional reaction to pain is normal. But in anxiety a strong mental pre-occupation can actually intensify the physiogenic ailment.[10] Similarly a neurotic or an unstable personality with passive-dependency might use back pain or any physical problem as a crutch for social problems and life situations.

Functional tenderness covers wide unanatomical regions at surface levels, is elicited by skin traction or pinching and can vary greatly since it is hallucinatory to the point of being forgotten with an amytal injection. There is an excellent capacity to hold posture and position, but little power to contract the same muscles willingly or to move against resistance. However one series[11] of 12,000 backaches in Ontario showed that 82 per cent of the patients were back at work within three weeks of their accidents, fewer than five per cent were disabled long enough for their illness to deserve the label "compensation back" and far fewer continued complaining for litigation purposes. Yet too often shaky psychosomatic theory precedes careful clinical examination and supposition replaces any factual base that could support enlightened therapy.[12]

Low back muscles are readily tensed and made painful by emotions because it is often in strong action that we are threatened by life situations. Such overacting muscles can set up referred pain by a mechanism similar to referred tension headaches produced by emotional tension in neck muscles; consequently, anti-depressants might be of therapeutic and diagnostic value.

M. Iatrogenic

1. manipulation
2. exercise

Macnab[13] has pointed to the limited but definite value of manipulation, but has also warned of the possible damage and increase of pre-existing pain that can be produced by over-zealous therapeutic manipulation such as forceful sudden rotational levered forces. Also, over-zealous spinal flexion and extension exercises for prophylactic postural purposes can inadvertently give muscular, ligamentous and discogenic strain.

PRINCIPLES OF MANAGEMENT

1. *BED REST*. Immobilization in a position of comfort (the best being supine with hip flexion maintained by pillows behind the knees, or on the side with the knees drawn up) should be maintained for two or three days on a firm, felt or foam mattress with fracture boards underneath. Any movement, such as sitting to eat or walking to a toilet must be avoided in the acute period. Traditionally, Buck's pelvic skin traction of 10 lbs. is used to reduce muscle spasm but it merely acts on the femuro-acetabular joint and helps to keep the patient in bed. Effective tension is obtained by a lumbar traction of 40 lbs. maintained for half-hour periods. This simple therapy augments the splinting effect of muscle spasm and hence minimizes it.[14]

2. *ANALGESIA*. (a) Acute early swelling is reduced by local cold such as ice packs. Later, moist heat improves circulation and relaxes spasm.

(b) Anti-inflammatory ASA is augmented by codeine although such narcotics are constipating and should be alternated with laxatives and discontinued as pain becomes tolerable.

(c) Tranquilizers may allay anxiety initially.

(d) Much-advertised skeletal muscle relaxant drugs have not been satisfactory, although Diazepam (Valium) has given some help yet unpredictably, mainly as a tranquilizer.

(e) Diathermy and infra-red are used instead of hot packs with hypertrophic osteoarthritis.

3. *SUPPORT*. (a) Muscle and ligamentous sprains recover in several weeks. Thus, support should only be applied during these early convalescent stages to prevent physical and psychological dependency and weakness later. Skin taping limits hyperextension and even active skin movement. Strains usually do not require support.

(b) Braces should not be applied without a definite concomitant exercise plan. The Williams corset (leather covered metal straps with abdominal laced support) is more flexible than the rigid Harris brace, but both limit lordosis adequately. A plaster cast should be discouraged.

(c) A pelvic belt allows hip flexion with direct traction on the pelvis being particularly useful for sacro-iliac strain with pubic involvement.

(d) Obesity, poor posture and other factors contributing to chronic strain should be minimized.

4. *PHYSIOTHERAPY*. Following several days rest to spastic muscles. a general preparation of heat and massage should lead to firm passive movement of fascial planes over each other.

Next, very mild flexion emphasizing pelvic tilting should begin as passive movements slowly progress to graded active ones.

Later pelvic rotation of the spine should be followed by strengthening of the rectus abdominis (by gradual steps such as sit-ups with flexed knees) to raise the front of the pelvis up and strengthening of the gluteus maximus to pull the back of the pelvis down.

Active prolonged stretching, initially isometric progressing to isotonic exercises, for a half-hour daily restores tone and mobilizes the lower back with most patients. But some will not mobilize well, probably due to fear of recurrence of symptoms and they will maintain limited range of motion. Since the tightness and some contracture persist, maintaining swayback, the back becomes susceptible to even minor stress injury. Another argument for building strong back muscles is that they reduce the effects of cartilaginous deterioration.[15]

5. *MANIPULATION*. In true orthopedic subluxation with no other demonstrable cause or with loose osteophyte bodies within the apophyseal joint this osteopathic technique may be beneficial although temporarily usually. However, it should not be attempted in root compression nor in doubtful cases nor performed too rapidly since it may exacerbate the symptoms.

6. *RETRAINING*. It is not necessary in most patients to teach more than just the proper mechanical way to perform functional activities of daily living, working and travelling — particularly those with disc complaints following back strain. It is useful to acknowledge the limitation of medical treatment in some chronic cases and to explain that relief may come eventually, depending on useful activity while recuperating, minimizing further strain, cooperating with the team of physician and therapists and vocational counsellors, avoiding pre-occupation with the back, and perhaps changing the occupation. Motivation is a significant factor. A difficulty in successful rehabilitation is that so much has to be done by the patient himself: careful posture, exercise, movement, mentality. Ther is no easy pharmacologic or operative remedy. The physician must convince the patient of the importance of this prolonged physical therapy.[16]

7. *SURGERY*. Pennal[17] has found that surgery plays a relatively minor role in treating low back pain and is probably the most elective of "elective operations":

(a) An urgent case however would be one with persistent backache, sciatic radiation and foot drop unimproved by three days complete bed rest; depression of the root by partial hemi-laminectomy is imperative to prevent ankle weakness.

(b) Myelography (laminography) and occasional discography and electromyography are indicated preoperatively. If discography reveals multiple level involvement this is a definite contra-indication to fusion and probably only decompression of the disc space is indicated. In patients over 50 fusion would be rarely if ever done.

(c) Surgical consideration is given in any bladder or bowel dysfunction with lax rectal tone and numb perineum or progressive neurological deficit or recurrent episodes of disabling pain in spite of adequate bed rest.

(d) Spinal fusion would be considered in a crush of the vertebra greater than 50 per cent of its height.

(e) A simple Achilles tendon lengthening procedure may greatly improve walking and posture in some cases.

PROPHYLAXIS

The relief of postural stress which underlies much of the pathology is the elimination of the increased lumbar lordosis. This is accomplished by tightening the abdominal musculature, keeping the head high to elevate the chest, rotating the pelvis under the flattened spine, keeping the hips flexed while sitting and sleeping, avoiding the childhood-learned prone sleeping position, reducing obesity and lowering the height of high heels.

Also constant careful examination of a growing child's posture, particularly during adolescence, with corrective suggestions, could save considerable future low back pains.

SUMMARY

Low back pain is a frequent problem, often difficult to diagnose and treat. This article reviews a wide range of causes and offers principles for their musculo-skeletal rehabilitation.

ACKNOWLEDGEMENT

My sincere thanks to Dr. Ian Macnab, Wellesley Hospital, for commenting on this article.

REFERENCES

1. Hirsch, C.: Low Back Pain Etiology and Pathogenesis, *Appl. Ther.*, 8: 857, Oct. 1966.
2. Dively, R. L.; Oglevie, R. R.: Pre-employment Examination of the Low Back, *JAMA*, 160: 856, 1959.
3. White, A. W. M.: The Compensation Back, *Appl. Ther.*, 8: 871, Oct. 1966.
4. Kelgren, J. H.: *Clin. Sci.*, 3: 175, 1938.
5. Adams, R. D. et al: Pain in the Back and Neck, *Principles of Internal Medicine* ed. Harrison, 36-46, fifth ed., 1967.
6. Lankford, L. L.: Postural Backache, *Am. Jour. Orthop.*, 6: 150, June 1964.

References continued on page 180

Recent Advances

Compression - A New Method Of Fracture Treatment

INTRODUCTION

Prior to the twentieth century open reduction as a method of fracture treatment was only indicated where prolonged conservative management had failed or where the fracture involved a subcutaneous bone; for example the patella or olecranon.

At the turn of the century, with the development of aseptic surgery, operative fracture surgery became more than a supplementary measure in the management of fractures. However, even then, the lack of inert materials with which to fix bone in apposition handicapped the internal fixation of fractures. In the years between the wars, alloys were developed which could remain in the tissues indefinitely without causing corrosion; and with this advance internal fixation became the method of choice in the following circumstances:

1. Inability to achieve reduction;
2. Inability to maintain reduction;
3. Certain fractures in which non-operative management is known to be largely ineffective (eg. fracture of radius and ulna in the adult);
4. Certain fractures in which non-operative management may compromise the general well being of the patient (eg. geriatric hip fractures);
5. Intra-articular fractures in which accurate restoration of joint surface is essential.

OBJECTIVES

The objectives of fracture treatment are to restore all the functions of the injured limb. This requires not only healing of the fracture after it has been properly reduced but also maintenance of the structural and functional integrity of the soft tissues. Aside from the trauma which resulted in the fracture itself, injury to soft tissue can occur when a fracture has united in an anatomically incorrect position or as a result of prolonged immobilization, leading to atrophy of subcutaneous fat, muscle and cartilage, stiffening of the joints and circulatory disturbances in the form of edema.

A technique of internal fixation of fractures utilizing compression has been developed which avoids the above mentioned complications of fractures by means of a fixation that is totally rigid and able to remain rigid during active but non-weight bearing motion.

METHOD

A group of Swiss surgeons developed a compression technique which secures absolutely rigid fixation by means of specially engineered devices. A compression plate is fixed to the shorter of the fracture fragments by means of deep threaded screws. The compression device itself is then attached to the longer fragment by means of a screw. This device has a small hook which fits into the last hole of the plate. The nut of the compression device is tightened and the two fracture fragments are impacted together with a pressure at the fracture site of about forty kilograms. The plate is then attached to the second fragment by means of the screws and the compression device is removed.

A plaster cast is rarely applied after operation (the exception being malleolar fractures). The limb is loosely bandaged; and, according to the preference of the surgeon, immediate non-weight bearing exercises can be started or wound healing can be allowed to proceed for four to six days before exercises are begun.

ADVANTAGES AND DISADVANTAGES

There is no evidence that compression of the bone ends stimulates osteogenesis. Its primary benefit lies in the fact that, by impacting the bone ends, there is an increase in rigidity of fixation and the space between fragments which must be bridged by new bone is narrowed.

In the experiment done by Ford, et al, observations confirmed that the beneficial effects of pressure on bone union are due to the more complete immobilization effected by pressure rather than to the pressure itself.

In the healing of any diaphyseal fracture there are three, possible four, areas of osteogenic potential — (1) periosteal reaction (2) endosteal or medullary callus (3) fracture hematoma and, possibly, (4) cortical ends.

Experimental fractures in the femora of dogs treated by compression showed large amounts of callus in the medullary canal. There was no evidence of new bone formed from the cortical ends of the fragments. Bone advanced from the medullary canal into space between cortical ends of fragments and united them. The bone formed directly from mesenchymal stroma with little evidence of endochondral ossification seen in fractures not treated by compression.

Compression treatment of fractures has the additional advantage, alluded to earlier, of premitting early, painless, non-weight bearing exercise. Such exercise reduces muscle atrophy and joint stiffness, thereby leading to a shorter period of disability.

The disadvantages of this method of fracture treatment are those of converting any closed fracture to an open fracture. With meticulous asepsis and careful attention to atraumatic technique this problem can be minimized.

Another disadvantage that has been suggested is the early resorption of the cortical ends in fractures fixed by compression. In an experiment using varying degrees of compression in the treatment of fractures of the ulnae of dogs, Friedenberg, et al, demonstrated that high degrees of compression caused necrosis of the cortex with osteoclasis and poor healing at the fracture site. However,

other experimenters have demonstrated that the degree of compression obtained by the compression plate did not result in any roentgenographic evidence of injury to compressed cortical ends. Microscopically an irregular loss of osteocytes from the cortical ends was found, but none of the fractures treated by compression resulted in non-union in contrast to two of the twenty-three fractures treated without compression in which resorption and non-union did take place.

INDICATIONS

The indications for the treatment of fractures by compression are essentially those outlined for operative fracture surgery with special value in six major fracture areas.

1. non-union of long bones
2. multiple bone fractures
3. fresh forearm fractures
4. femoral condyle fractures
5. selected hip fractures and osteotomies
6. severe ankle fractures

By and large the difficulties encountered in attempting a successful resolution of the problems posed by these particular fractures are obviated by the use of compression apparatus.

SUMMARY

Compressing fracture fragments and holding them fixed in this position by means of a uniquely designed compression plate and screw is a relatively new method of fracture management which owes its advantages to the rigid fixation obtained.

This rigidity expedites fracture healing by preventing motion through the fracture site and by reducing the space between the fragments which must be bridged. It further facilitates patient recovery by permitting early non-weight bearing exercises with the result that muscle atrophy and joint stiffness are reduced. The result is faster rehabilitation of the whole patient which is one of the primary aims in fracture treatment.

S. Stafford 6T9

ACKNOWLEDGEMENT

I would like to express my appreciation to Dr. Ian Macnab and Dr. H. Larocca for their advice in preparing this article.

REFERENCES

1. Adams, J. C.: Outline of Fractures. London: Livingston Ltd. (1957).
2. Anderson, L. D.: Compression Plate Fixation and the Effect of Different Types of Internal Fixation on Fracture Healing, J. Bone and Joint Surg. 47-A: 191 (1965).
3. Ford, L. T.; Tottes, J. O.; and Key, J. A.: Experimental Study of the Effect of Pressure on Healing of Bone Grafts. Arch. Surg. 62, 475 (1951).
4. Friedenberg, Z. B. and French, G.: The Effect of Known Compression Forces on Fracture Healing. Surg. Gynec. Obstet. 94, 743 (1952).
5. Müller, M. R.; Allgower, M.; and Willenegger, H.: Techniques of Internal Fixation of Fractures. New York: Springer-Verlae, Inc. (1965).
6. Smith Kline Instrument Company: AOI Orthopedic Instrument and Implant System. Philadelphia, Pennsylvania (1966).

No. 5090 Tycos
Cuff-Mounted Aneroid

TYCOS®

ANEROIDS

TYCOS Aneroids have been a favorite with hospitals and doctors for over 50 years. Main reason: accuracy. **TYCOS** Aneroids are so accurate and dependable we give you this bold warranty: If a **TYCOS** loses accuracy for any reason during the first ten years, we'll readjust it without charge (replacement parts extra).

Choose from Hand Model with gauge on bulb, No. 5098; or Cuff-Mounted, No. 5090. Only $56.50 at your authorized **TYCOS** Surgical Supply Dealer.

(R) Trade-Mark

Taylor Instrument Companies of Canada Ltd.
75 Tycos Drive, Toronto 19, Ontario

Taylor Instruments

MEAN ACCURACY FIRST

Eponyms And The Men

Versatility has been the hallmark of the names mentioned throughout this section in previous issues. Such is true of the following physician. The leading Irish surgeon of the early nineteenth century was (a) an accomplished carvdiovascular surgeon, being the first man to tie the subclavian artery within the Scalene muscles (1816) and the first to tie the innominate artery successfully (b) a skilled anatomist, as his 1811 and 1825 surgical treatises demonstrated (c) an immunologist of sorts, shown by his research of pregnant women bearing syphilitic children, and (d) a renowned orthopaedist. His name? ABRAHAM COLLES (1773 - 1843) of fracture fame.

BARON GUILLAUME DEPUYTREN (1777 -1835), the "Brigande of the Hôtel Dieu", was born in central France. The son of a poor advocate, he was kidnapped as a boy by a rich lady from Toulouse on account of his good looks and, after reclamation, was taken to Paris and educated by a rich cavalry officer. As a medical student, however, he endured poverty, allegedly reading books by the light of oil prepared from cadavers. He became Surgeon-in-Chief at the Hôtel Dieu at the age of 36 and worked tremendously hard at teaching, operating, and seeing 10,000 private patients per year. He accumulated great wealth and was probably a most unpleasant person to meet, but his writings are delightful to read for their lucid descriptions and deductive reasoning. Like several of those mentioned here, he combined accurate clinical observation with a great interest in pathology. The best account of *Depuytren's contracture* was given by *le baron* in a lecture in 1833 and was published in the *Lancet* the following year.

PERCIVAL POTT (1714 - 1788) was as great a medical writer as surgeon. The largest surgical practice in London did not prevent him from turning out masterpieces on hernias, fistulae in ano, head injuries, hydrocoeles, fractures and dislocations, and paralysis from spinal deformities, all between 1756 and 1779. Ironically, his extensive authorship began while he was bedridden supposedly (but probably not) as a result of the fibular fracture which bears his name. His kindly, charitable nature and superb lecturing ability attracted patients and students alike to St. Bartholomew's for 43 years.

As so frequently occurs in many varied disciplines, the same school bred another great orthopaedic surgeon a century later. SIR JAMES PAGET (1814 - 1899) of *Paget's disease* or osteitis deformans was, like Pott, associated with St. Bart's most of his life. He was surgeon to Queen Victoria and received a baronetcy in 1871. A warm friend of Virchow and a respected surgical pathologist, Paget was elected President of the Royal College of Surgeons in 1875. Known as an astute clinician, he published descriptions of eczema of the nipple and mammary cancer.

Volkmann's ischaemic contracture was named by RICHARD VON VOLKMANN (1830 - 1889), whose entire life was spent in Halle, Saxony, where his father was Professor of Anatomy and Physiology. He studied at several universities and graduated at the age of 24. Two years later he became deputy Professor of Surgery and subsequently Director. Volkmann instituted Lister's antiseptic methods at the hospital; it had previously been subject to so much infection that surgery was almost impossible. He wrote popular fairy stories and poems under the pseudonym Richard Leander, and also founded a surgical journal.

HUGH OWEN THOMAS (1834 - 1891) came from a line of Anglesey bone-setters. His father practised in Liverpool and sent all his sons to medical school. Hugh Owen qualified and, after a brief period working with his father, practised on his own. He never had a hospital appointment and made a habit of treating his patients at home. His special interests were lithopaxy, the management of the acute abdomen, and orthopaedics. His ideas became accepted despite his unconventional background and his intolerance of others. Thomas advocated prolonged and uninterrupted rest for the treatment of tuberculous joints. His arsenal of splints was superbly designed to achieve this and they remain widely used; he devised the surgical collar, metatarsal bar, heel wedges, and the knee splint which bears his name. He was able to fit a patient at a moment's notice.

LOUIS OLLIER (1830 - 1900) was one of the greatest men in orthopaedics. He devoted his life to his work; in addition to several important clinical papers, he carried out research on normal and pathological bone growth, considering it not only as an anatomic structure but also as a tissue. Ollier was born at Vans in Ardèche and studied at Lyons and Montpellier. At the age of 30 he was appointed senior surgeon at Lyons. In the 1870 war he was a battle surgeon, attending to the wounded for both sides. In 1894 he was decorated with the Order of Knight of the Legion of Honour by the French President. A few hours after the ceremony the President was assassinated and Ollier was called to him, but his injuries were too severe for Ollier to be able to save his life. He described, in 1899, the eponymous condition *dyschondroplasia or Ollier's disease.*

Gordon D. Hardacre, B.Sc. 7T0

REFERENCE

Anthology of Orthopaedics
Rang, M.
E. & S. Livingstone Ltd., Edinburgh and London, 1966.

Orthopedics - The Absence Of Low Back Pain

We know from archaeological investigation that the absence of low back pain has flourished among large segments of the population as far back as Pithecanthropus Erectus. However, very little attention has been paid to it in the past, largely because it was poorly understood and there was very little known about its management. In recent years, with the accumulation of more data, an attempt has been made to organize a classification of the absence of low back pain and a rational therapeutic approach to the patient who presents without low back pain. This article shall attempt to summarize the present state of knowledge, and the author apologizes in advance for the necessarily brief treatment of each fascinating aspect of the topic.

DEFINITION

The absence of low back pain was first clearly described in the classical paper of J. Hailey Bailey in 1864: ". . . wherein the patient admits of a peculiar subjective feeling of comfort and well-being localized to the lumbar and sacral regions of the dorsal spine withal."

CLASSIFICATION

Several attempts have been made to classify the absence of low back pain, but most of them have only confused the issue. Farber and Guckblatt have proposed the first truly useful scheme, and a modification of their organization follows.

MODIFIED FARBER AND GUCKBLATT CLASSIFICATION OF ABSENCE OF LOW BACK PAIN

I Congenital (i.e. absence of low back pain from birth)

This is a very common syndrome, occurring in over 95% of Caucasians and a similar number of Negroes and Chinese, not to mention Polish Jews, but in most cases the condition is self-limiting.

II Acquired

A *Infectious*
— due to:
1 - absence of spinal tuberculosis
2 - absence of bacterial meningitis
3 - absence of abscess
4 - absence of miscellaneous organisms (extremely common)

B *Traumatic*
— due to:
1 - absence of injury to the lower back
2 - transection of the spinal cord in the cervical or thoracic regions

C *Inflammatory*
1 - absence of arthritis
2 - absence of myositis or lumbago

D *Visceral*
1 - absence of pyelonephritis
2 - absence of gynecological causes

E *Neoplastic*
— absence of myeloma, prostatic carcinoma or other secondary neoplasms

F *Idiopathic recurrent absence of low back pain*
— a peculiar syndrome characterized by a long course of repeated episodes of no low back pain, believed now to be due to an autoimmune mechanism.

G *Paroxysmal absence of low back pain*
— absence of low back pain of sudden onset, frequently experienced by young Japanese women following labour and delivery.

H *Mixed*
— absence of low back pain associated with any of a number of factors all absent at the same time.

DIAGNOSIS

In many cases the diagnosis is difficult to make. The patient with no complaints referrable to the lower back, and in all likelihood will not even mention his absence of low back pain unless it is deliberately sought by the physician. Usually it is an incidental finding during a routine investigation of some unrelated condition. However, the astute clinician will not be misled by the patient's disregard for his absence of low back pain, since it is just this complacency which leads to so many false-positive diagnoses; for if a careful, thorough and rigorous physical examination is carried out, including isometric resistance tests, vigorous vertebral percussion, and back-bending exercises, one frequently finds that the patient does not in fact have absence of low back pain at all. Laboratory studies are seldom of real value, although one cannot overlook the importance of a lumbar puncture to rule out absence of bacterial meningitis as a cause.

TREATMENT

In almost all cases the symptomatic treatment is the same: a regular program of prolonged periods of idle standing separated by vigorous exercises and straining, stool-hardening agents, and on occasion local injections of bradykinin. For the particular type of absence of low back pain one must further treat the underlying cause where possible. In the case of absence of arthritis or neoplasm there is little that can be done, but in the absence of bacterial meningitis or tuberculosis, the usual avoidance of antibiotics is sufficient. For idiopathic recurrent absence of low back pain the only established regimen is lack of rest and reassurance, but recent work at the Wakefield Laboratories shows promise of a new chemotherapeutic approach using the digestive enzymes of the avocado.

CONCLUSION

Physicians are finally taking it upon themselves to deal with the absence of low back pain in the manner it deserves. With the ever-growing interest in this condition now spreading to pediatrics (where over 90% of all absence of low back pain occurs) one can only postulate on how tremendously profitable the new knowledge will prove to be, both to the patient and to the pediatrician alike.

A. J. Shoichet 6T9

Clinicopathological Conference

Skin Rash And Progressive Muscular Weakness In A Seventy-Three Year Old Female

CASE PRESENTATION

A 73-year-old white female was admitted to hospital because of skin rash, arthralgia, marked myalgia, malaise, fatigue and anorexia of approximately six months' duration.

The patient was well until two years before admission when she developed progressive shortness of breath accompanied by pain in the chest while at rest and swelling of feet and legs. She was treated with nitroglycerine, digitalis and diuretics and improved.

Six months before admission she developed bilateral leg cramps. Three months later a skin rash developed originating over the forehead and spread distally over face, neck, arms, trunk and thighs in that order. At the same time she noticed pain in the muscles and joints of the limbs especially the arms. She required help to get out of bed, had difficulty walking and dressing. She claimed a 51 lb. weight loss over the preceding year.

In the week prior to admission the patient developed difficulty swallowing and nasal regurgitation. Her voice became hoarse. She noted shortness of breath when lying flat and was wakened from sleep by dyspnoea.

Examination on admission revealed a chronically ill woman of 73 who was cachectic and breathing with difficulty. A morbilliform rash was noted involving face, trunk and legs; on the arms it was papular. The eyebrows were absent, the conjunctivae pale, and the hard and soft palates erythematous. The eyes were not dry, there was no cervical lymphadenopathy, the thyroid was normal and the trachea central. Dorsal kyphoscoliosis was present. Rales were noted over the right upper lobe and rhonchi were scattered throughout the right lung.

Respiratory rate 40; blood pressure 130/70; heart rate 120, rhythm regular; temperature normal.

The heart sounds were distant; a grade 2/6 systolic ejection murmur maximal in the fourth left interspace at the sternal border was heard. It radiated towards the base of the heart along the sternal border. Traube's space was dull; otherwise abdominal examination was negative. Stool occult blood was negative. Warty lesions of variable size were noted on the left labium and both inguinal areas. Rectal and pelvic examinations were clear. Wasting of the girdle muscles was noted and marked weakness of these muscles as well as the triceps, biceps, knee flexors and extensors was demonstrated. Full range of joint motion was maintained although the patient complained of pain at the extremes of movement. Neurologic examination was normal. There was no lymphadenopathy.

Laboratory studies showed: normal urinalysis; E.S.R. 60 mm/hr; Hb. 11.5 gm%; W.B.C. 9100-N.82, B.O, E.5, L.10, M.3; retic count 2.7%; slight anisocytosis with normal platelets; B.U.N. 36; creatinine clearance 44 ml/min/1.73 sq. M; 24 hour urine creatine 412 mg, E.C.G. showed occasional V.P.B.'s, S.T. segments depressed in A.V.L., V5,6., T-waves shallow in leads 1, A.V.L., V5,6. Chest X-ray showed marked dorsal kyphosis with right scoliosis; some unfolding of the arch of the aorta with calcium in it. Alkaline phosphatase 124, S.G.O.T. 53, Creatine Phosphokinase 152. Latex fixation and LE cells negative.

The patient was continued on digoxin and 60 mgm of prednisone daily was started. On the fifth hospital day because of increasing dyspnoea oxygen was begun. On the thirteenth hospital day the rash and the patient's muscle power improved. She remained quite dyspnoeic at rest. For the next 35 days however she continued slow recovery; her breathlessness lessened so that she could sit in a chair for short periods. At the beginning of the seventh week the patient became lethargic once again and was noted to be jaundiced. The liver was non-tender and palpable 1½ fingers below the right costal margin; the surface was smooth, the consistency firm and the edge sharp. The abdomen was distended; shifting dullness and a fluid thrill were detected. Asterixis, spider telangiectasiae and splenomegaly were absent.

The B.U.N. was now noted to be 25; alkaline phosphatase 248; S.G.O.T. 112; L.D.H. 98.4 and S.G.P.T. 34.2; prothrombin time 12.5 seconds (control 12); C.C.F. negative at 48 hours; thymol turbity 6.5.

The patient continued to deteriorate, developed chills with fever of 102°F, became progressively more short of breath and the jaundice deepened. She died on the sixtieth day.

DISCUSSION OF DIFFERENTIAL DIAGNOSIS

This patient was well until aged 71 years when she developed a syndrome suggestive of congestive failure associated with myocardial ischaemic pain. On drug therapy she made a good recovery and was active once more. In view of her preceding good health and her advanced age, arteriosclerotic coronary artery disease seems the most likely explanation for this illness.

Six months before admission, skin rash and pain in the joints and limb musculature developed, followed shortly by remarkable muscle weakness. She had lost approximately 50 lbs. in the twelve months preceding hospitalization. In the week before entry, hoarseness, difficulty in swallowing and orthopnoea developed. Examination on admission revealed erythema of the palates and most of the body skin. Weakness and wasting of the proximal and girdle muscles were demonstrated. She was dyspnoeic, had tachypnoea and rales and rhonchi were noted in the right lung. She was afebrile without abnormality of abdominal structures, lymph nodes, joints or nervous system. Laboratory studies showed elevated E.S.R., normal W.B.C., mild anaemia, normal urine sediment and azotaemia with low GFR. However, in view of the later B.U.N. of 25 and the absence of other evidence of renal disease, this initial suggestion of renal vascular and/or glomerular disease may have been spurious on the basis of dehydration. The E.C.G. changes are consistent with digitalis therapy. The dorsal kyphoscoliosis could explain the right sided lung signs through distortion of the right bronchial tree, poor drainage from these areas and possibly bronchiectasis. The remarkable abnormalities are the high creatine phosphokinase, modest elevation of S.G.O.T. and alkaline phosphatase and urine creatine.

The muscle disease dominates the clinical picture and explains nearly all the symptoms and signs. The dyspnea was likely due to poor ventilation on account of defective diaphragmatic and intercostal function; the dysphagia and nasal regurgitation were likely consequent to pharyngeal muscle (striated) dysfunction. Degenerative, infectious and neuromyogenic processes can be dismissed. Thyrotoxic myopathy with apathetic hyperthyroidism is the only metabolic contender. However, the muscle disease in hyperthyroidism is seldom so severe in the absence of more remarkable vascular signs of toxicity or sympathetic overactivity and a goitre is usually detected. Myasthenia gravis can cause dysphagia, dysphonia, dyspnoea and skeletal muscle weakness. Skin rash is a rare feature, muscle wasting is not an early sign and the muscles of the head and neck are most commonly and usually the earliest to be involved in this disorder. In the absence of any note describing a Tensilon test and noting the use of Prednisone by her physicians rather than one of the anticholinesterase drugs, myasthenia gravis can be set aside.

Of the collagen-vascular diseases lupus erythematosis and dermatomyositis claim attention. The disseminated rash, normal blood pressure, normal W.B.C. and urinalysis and negative LE cell test argue strongly against the former. However, the entire clinical syndrome could be explained by dermatomyositis. As a result of the dissolution of muscle cells caused by the inflammatory process, intracellular enzymes especially creatine phosphokinase and aldolase are released into the extracellular fluid. The source of muscle energy, creatine phosphate, is not converted to creatinine in the usual fashion allowing increased amounts of the former chemical to accumulate and be available to leak from the damaged cells. Involvement of the respiratory and deglutition muscles is common and pneumonia with respiratory failure is a common mode of death. Glucocorticoid steroids are the best form of drug therapy and can induce remarkable remissions in many cases. Such seemed to occur in this patient.

However, seven weeks after treatment was instituted she became jaundiced and hepatomegaly and ascites were detected. This turn of events was almost certainly due to a recent process in the liver in view of the absence of any abdominal abnormalities earlier. She had received no infamous hepatotoxic agents and had not been transfused. History had revealed only anorexia and extreme weight loss as possible digestive symptoms. The jaundice and high alkaline phosphatase (twice as high as at the time of admission) with normal LDH, borderline S.G.P.T. and modest increase in S.G.O.T. levels are compatible with extrahepatic biliary obstruction, intrahepatic cholestasis or infiltrative disease of the liver. The ascites and normal prothrombin time are points against the first of these; no agents commonly associated with the second diagnosis (androgenic steroids rather than glucorcorticoid steroids are common culprits) were used. Of the infiltrative disorders, cancer is the best bet. Most experts, furthermore, point out that the finding of dermatomyositis in someone over the age of 40 demands exclusion of occult carcinoma usually originating in the female reproductive organs, the lung, the breast or the gastrointestinal tract. Physical examination and X-ray studies excluded most of these leaving the digestive tract as the best possible source of a carcinoma, with the stomach or perhaps the colon being the most likely sites in this tract. In view of the anorexia and great weight loss (which predated the muscular symptoms) cancer of the stomach seems the best possibility. Extension to serosal surfaces could be associated with malignant ascites and metastases spreading to the lymph nodes in the porta hepatis or liver parenchyma could explain the hepatomegaly. The smooth contour is unusual in an enlarged liver from infiltrating cancer metastases, but is not unknown.

The patient died with deepening jaundice and recurrent respiratory difficulties.

My final diagnoses are:

1. Cancer of the stomach with extension to serosal surfaces, malignant ascites and extensive hepatic metastases.
2. Dermatomyositis — associated with visceral malignancy.
3. Bacterial pneumonia especially of the right lung — perhaps with evidence of aspiration.
4. Arteriosclerotic coronary artery disease — probably with myocardial scarring somewhere consequent to a remote myocardial infarction.

PATHOLOGY SUMMARY

Four months before death, this seventy-three-year-old woman developed a skin rash, which began on her forehead and face and spread to involve other areas of her body. This was accompanied by arthralgia and myalgia. Two months before death, she was admitted to hospital and a biopsy of left deltoid muscle confirmed the diagnosis. Two weeks before death, the patient developed jaundice which was progressive. She deteriorated rapidly and it was felt she had an underlying malignancy. She died on September 8th, 1968.

At autopsy there was no evidence of acute myositis. The muscles examined showed a more quiescent picture with sarcolemmal nucleus proliferation, atrophy and fibrosis suggesting regeneration and healing of the myositis. The changes in the skin consisted of fibrous thickenening of the dermis of slight degree resembling that seen in scleroderma. Inflammatory changes were absent in the skin.

This patient had malignant tumours of uncommon sites. There was extensive adenocarcinoma involving the biliary system with a large fungating carcinoma at the fundus of the gall bladder and adenocarcinoma involving large portions of the extrahepatic bile ducts. There was an adenocarcinoma of the first portion of the duodenum whose appearance was also compatible with a primary carcinoma although the possibility of a metastasis from the gall bladder could not be excluded. The jaundice was due to extrahepatic obstruction of the common bile duct by tumour. .

There was evidence of chronic cholecystitis and a single gall stone was present at the neck of the gall bladder. There was a perforation of the gall bladder which led to generalized acute peritonitis with the formation of right subdiaphragmatic and peripancreatic abscesses. Evidence of pancreatitis with fat necrosis was also found.

This is an example of a patient with dermatomyositis complicated by malignancy. The immediate causes of death were acute peritonitis and extensive acute bronchopneumonia.

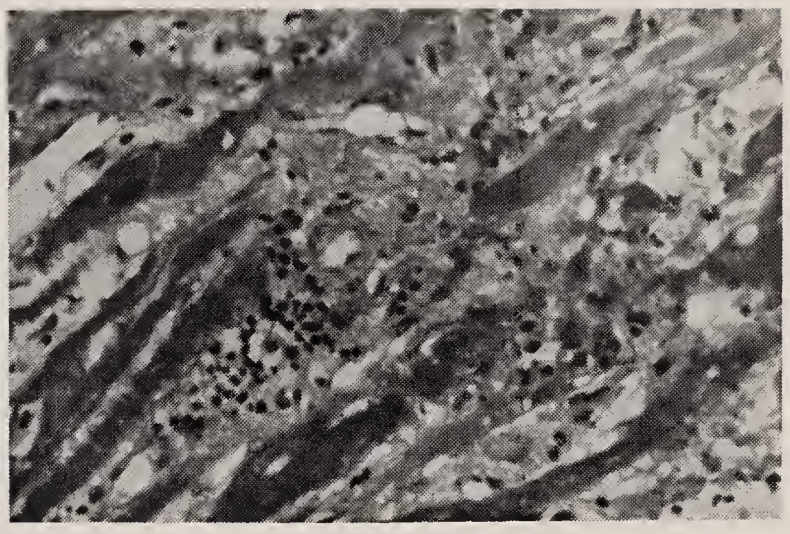


FIG. 1. Biopsy specimen showing non-specific myositis.

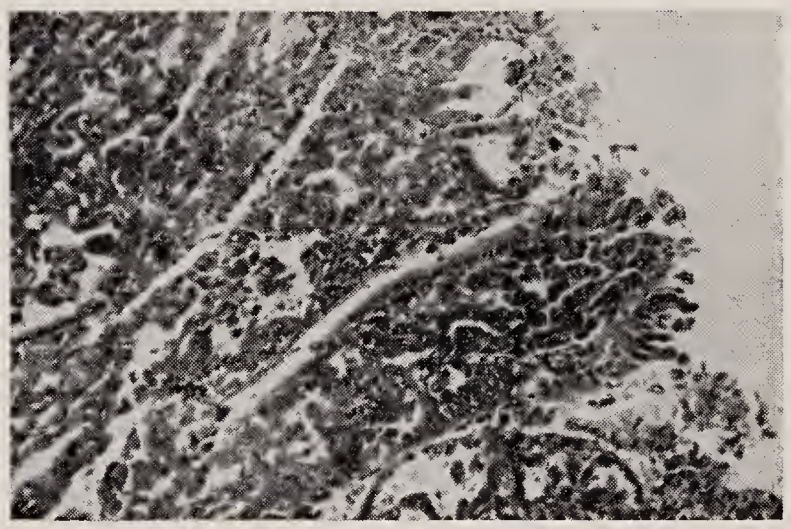


FIG. 2. Adenocarcinoma of the first portion of the duodenum.

DISCUSSION

Dermatomyositis is a diffuse inflammatory and degenerative disorder of striated muscle which causes symmetrical weakness and, to a lesser degree, atrophy of muscle.

The disease may occur in all age groups but is more common in mid-adult and later life. The disease is grouped with the collagen or connective tissue diseases. In addition, a link seems to exist between certain cases in which a visceral malignancy is associated with the myositis.

The disease is characterized by an acute or sub-acute muscular weakness, chiefly proximal in distribution, as the main feature. The typical skin eruption is a diffuse erythematous, sometimes edematous eruption on the face, about the eyes, on the anterior and posterior neck, the shoulders, the arms and the upper chest. Also, a scaly erythematous and often atrophic rash may occur on the extensor surface of the knuckles, elbows, knees and medial malleoli. The skin rash may precede or accompany the onset of the myopathy.

Systemic features such as malaise and leukocytosis are common. Sub-acute joint symptoms as a transitory arthralgia or arthritis occur often at the onset of the disease.

The course of the disease is highly variable. In some cases the clinical course is one of spontaneous exacerbations and remissions. In other cases the disease is progressive and unrelenting. Usually, at first, the patient notices difficulty in performing routine activities such as climbing stairs or lifting objects. Soon a clumsy gait may occur and there is a tendency to fall. At about this time the patient may note anterior neck muscle weakness accompanied by dysphagia, dysphonia or both. Rarely the patient notes muscular pain and tenderness. Muscular atrophy is usually a late event and is usually mild or moderate in extent unless the myolytic process has been severe during the acute stages. In severe or advanced cases the weakness may be extreme, and progressive muscular enfeeblement including respiratory muscles may prove fatal.

In all suspected cases of dermatomyositis, and especially in those over the age of forty, a detailed search for the presence of an occult visceral malignancy should be made. The figures vary in the literature but some studies quote figures as high as thirty per cent of the patients in the older age groups eventually prove to have some form of an underlying malignancy. The malignancy may arise before, after, or concurrent with the onset of the skin rash and muscle weakness.

Death is almost invariably from progressive muscular weakness which may manifest itself as severe dysphagia, malnutrition, aspiration, and respiratory failure with superimposed pulmonary infection. It is worth noting however, that complete surgical resection of a malignancy has occasionally been followed by total remission of the myopathy.

Nearly all the routine laboratory tests may be normal in the disease with the exception of an elevated sedimentation rate. There may be alteration of certain acute phase reactants such as the C-reactive protein, and some abnormal electrophoretic results, the most frequent being elevations of the alpha-2 or gamma-globulins. In the acute phase a polymorphic leukocytosis may occur, anaemia is rare except in cases where an underlying malignancy is present. LE cells are rarely found, however, latex fixation tests and tests for other rheumatoid factors are positive in about 50% of cases. The serum and urine creatine and creatinine levels are frequently abnormal but these abnormalities are not specific for the diseases. The greatest aid to diagnosis and prognosis are the levels of various serum enzymes such as the transaminases, aldolase, or creatine phosphokinase. These enzymes are seen to return to normal levels as the myopathic process begins to respond to corticosteroids, and are hence an indication of the success of therapy.

Once the diagnosis of dermatomyositis is made, therapy is directed along a course of 50 to 60 mg of prednisone daily, in three or four divided doses. Usually, if the dosage is sufficient, serum enzyme levels will return towards normal in two to four weeks, usually followed in three to four weeks by an improvement in muscle power. If, however, the enzyme levels do not decline it is advisable to increase the dosage by 50%. It must be emphasized that attempts to decrease the daily dosage must be done very cautiously in order to avoid an acute exacerbation. The daily maintenance dosage in most patients averages 12.5 mg of prednisone (range 7.5 to 20 mg) and is reached only after approximately six months.

The etiology of the disease is not known; however many factors have been considered as possible precipitants of the disease. The only relationship that holds up in any statistical fashion appears to be the association of the disease with a malignancy. Several ways in which the tumour could be implicated as a cause of the disease have been postulated.

These include:

1. The initiation of an immunological or hypersensitivity reaction by the tumour antigens which have similarity to antigens present within the muscle fibres.
2. Elaboration of a myotoxic substance by the tumour.
3. The tumour may utilize a nutrient vital for muscle integrity.

In any case, only a minority of patients show the presence of a malignancy and hence the etiology of the disease remains an enigma.

A. M. Kruger 6T9

ACKNOWLEDGEMENTS

Special thanks to Dr. L. F. W. Loach, Dept. of Medicine, Toronto General Hospital, for his discussion of the differential diagnosis; and Dr. J. S. Carruthers, Dept. of Pathology, Wellesley Hospital, for his summary of the autopsy findings and photographs; also the Dept. of Photography, Wellesley Hospital for their assistance.

REFERENCES

1. Copeman, W. S. C.: Textbook of the Rheumatic Diseases, E. & S. Livingstone Ltd., London 1965.
2. Gardiner, D. L.: Pathology of the Connective Tissue Diseases, Edward Arnold Ltd., London 1965.
3. Hill, A. G. S.: Modern Trends in Rheumatology, Butterworth's, London 1966 (Vol. 1).
4. Robins, S. L.: Textbook of Pathology, W. B. Saunders Co., 1960.
5. Walton, J. N.: Disorders of Voluntary Muscle, J. & A. Churchill Ltd., London 1964.
6. Williams, Ralph C.: Dermatomyositis and Malignancy, Annals of Internal Medicine, 50: 1959.

Continued from page 172

7. Wilson, J. C.: Low Back Pain and Sciatica, *JAMA*, 200: 8, 705-712, May 22, 1967.
8. Hirsch, ibid.
9. Digby, J. W.: Rheumatologist's Approach to Low Back Pain, *Appl. Ther.*, 8: 943, Nov. 1966.
10. Walters, A.: Emotions and Low Back Pain, *Appl. Ther.*, 8: 868, Oct. 1966.
11. White, ibid.
12. Walters, ibid.
13. Macnab, I.: Manipulation in Low Back Pain, *CMAJ*, 79: 125, July 15, 1958.
14., 15. Godfrey, C. M.: Physical Therapy in Treatment of Low Back Pain, *Appl. Ther.*, 8: 950, Nov. 1966.
16. Schaeffer, J. N.: Factors in Total Rehabilitation Programs for Low Back Pain, *Jour. Occup. Med.*, 9: 12, Jan. 1967.
17. Pennal, G. F.: Orthopedic Aspects of Low Back Pain, *Appl. Ther.*, 8: 1009, Dec. 1966.

Elastoplast Anchor Dressing

For wounds in awkward places

Shaped to resemble the letter "H", these sterile elastic dressings are ideal for dressing knuckles, heels, toes and other hard-to-bandage places.

Elastoplast Anchor Dressings expand and contract with every movement of joint or body. The adhesive is porous to promote natural healing.

Cartons of 100 dressings, 3″ x 1½″, individually wrapped and sterilized.

For further information write to:

S&N Smith & Nephew Limited, 2100 - 52nd Avenue, Lachine 620, P.Q., Canada.

water-dispersible, hypoallergenic, pleasant-tasting

OSTOCO® DROPS

Children relish the flavour of multivitamin OSTOCO Drops, and welcome their administration directly on the tongue, thus ensuring the most effective absorption. OSTOCO Drops provide the vitamins which are most important to infants and young children. Equally acceptable in formula, fruit juice or milk.

Each 5-drop dose (0.25 cc.) contains:

Vitamin A..... 2500 I.U.	Vitamin B_1..... 1 mg.
Vitamin D..... 400 I.U.	Riboflavin (vitamin B_2) ... 0.6 mg.
Vitamin C..... 30 mg.	Niacinamide ..... 4 mg.
	Vitamin B_6..... 0.6 mg.

Dosage: Infants and children under 6 years of age, 5 drops daily.

Bottles of 8, 15, 30 and 50 cc., each with calibrated dropper for waste-free dosage.

Full information on request.

QUALITY PHARMACEUTICALS
Charles E. Frosst & Co.
MONTREAL CANADA
FOUNDED IN CANADA IN 1899